ECOLOGY AND ENVIRONMENTAL MANAGEMENT IN DEHRADUN DISTRICT

ABSTRACT

OF THE

THESIS

SUBMITTED FOR THE AWARD OF THE DEGREE OF

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IN

GEOGRAPHY

BY

KAZMA KHAN

UNDER THE SUPERVISION OF

PROF. ABDUL MUNIR

DEPARTMENT OF GEOGRAPHY
ALIGARH MUSLIM UNIVERSITY
ALIGARH (INDIA)

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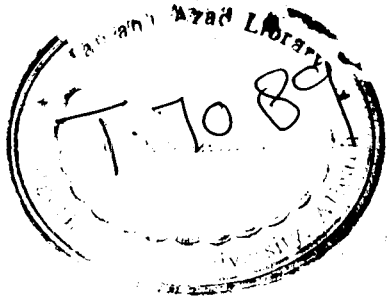

ABSTRACT

Ecology is a study of organisms in their natural home or habitat and its objective is to discover and understand the relationship between living things and their environment

Environmental management is the reduction or minimization of the impact of human activities on the physical and ecological environment. Environmental management is proper and natural with scientific resource use and management.

A key to a cardial solution lies in an understanding of the nature of the ecological balance in terms of macro and micro ecosystems and a planned management of environmental resources on a truly rational and scientific basis.

The objectives of the present study are:

- To explain the concept of ecology, environment and environmental management as well as determinants of ecology and environment;
- To examine the spatio-temporal distribution of natural, genetic and socio-economic environment;
- To assess different issues and problems related to the ecological and environmental management

The study is based on the analysis of statistical data covering the period during 1981 to 2001 for the analyses of ecology and environmental management, collected from both secondary and primary sources at block and village level.

Secondary data have been obtained at district and block levels from various government organizations. The primary data were collected through well

prepared questionnaire, taking into account of all the variables related to ecology and environmental conditions. On the basis of structure, relief, drainage, climate, soil, water table, land-use pattern and size of the population, the area under study has been divided into three ecological zones and from each zone two villages have been selected for intensive environmental study. Household survey is based on stratified sampling taking 10 per cent samples.

The district of Dehradun, extending between 29°58' to 31° 2'30" North latitudes and 77°34'45" to 78°18'30" East longitudes, covers an area of 3,088 sq.km. The region enjoys sub-tropical to sub-temperature climate. The average annual rainfall of the district is 2073.3 mm. The district supports a population of about 12, 82,143 persons with an average density of 415 persons per square kilometer. The average literacy rate of the district is 68.36 per cent with 74.36 male literates and 61.58 per cent female literates.

Keeping in view of the problem, the present study has been divided into seven productive chapters. In chapter first, the researcher has tried to deal with the conceptual framework of ecology, environment and environmental management as well as determinants of ecology and environment and geographical base of the study area. Besides, statement of the problem, aims and objectives, review of selected works, database and methodology have also been discussed. The geographical profile of the study area has been described in chapter second. The chapter third presents the suitable ecological basis of environmental management. Chapter fourth describes the natural environment in terms of forests and mining. Chapter fifth is devoted to the study of genetic environment. This chapter incorporates the study of agriculture and livestock. The socio-economic environment has been dealt in sixth chapter. This chapter has been divided into

three parts, namely, demographic setting, urbanization and tourism. Chapter seventh is devoted to the ecological profile of the sampled villages. This chapter is based on primary survey. It comprises of various variables related to natural and genetic environment, socio-economic environment, household environment, mode of employment and income level and infrastructural development. In the last, the conclusion and suggestions have been incorporated in the study.

The study of the natural environment focuses with the theme of forest and mining. As far as the distribution of forest is concerned, Chakrata block has registered the highest composite score, whereas the lowest composite score has been recorded in Kalsi and Vikas Nagar blocks because the topographic and climatic conditions in Chakrata block are favourable for the growth of forest while the Kalsi and Vikas Nagar blocks are mainly agricultural blocks so more and more forested area has been cleared for the cultivation of crops. The other blocks of the study area show medium level of distribution of forest. 0n the other hand mining is another aspect of natural environment. The study region is well known for their economic potentiality due to abundance of economic minerals like limestone, limestone marble, phosphorite and gypsum. All these minerals are located in the Krol belt viz infra krol, krol and Tal formations. The study reveals that haphazard and unscientific mining operations destabilize slopes, lead to excessive soil erosion and landslides, formation of badlands, generate dust and noise.

It has been concluded through the study of genetic environment that high level of agricultural development is found in the upper central part of the study area. This portion attained this status due to a variety of reasons. The farmers living in this portion enjoy better irrigation facilities; cropping intensity is high with plenty of agricultural workers coupled with more production of food grains.

The medium level of agricultural development is found in the lower central part of the study area. In 1981 and 1991 Raipur block was in the medium grade but in 2001 it came in low grade because in 2000 Dehradun district become the capital of Uttarakhand state so more and more non-agricultural development has taken place. Chakrata block shows low level of agricultural development in all the three decades because of its topographic and climatic conditions. Chakrata and Kalsi blocks record high level of livestock development, because these blocks are less populated and have more rural pockets. Vikas Nagar and Sahaspur blocks, located in the center of the district, show medium level of livestock development in all the three decades. In the previous decades Doiwala block was under the medium grade but in the last decade it came under the low grade whereas Raipur block shows low level of livestock development in all the three decades.

Population, urbanization and tourism are the main aspects of socio-economic environment. The population growth shows two discernible trends, a decreasing population trend till 1921 and a continuous increase since 1921. As a result of increased health care the mortality rate has gone down and the family planning measures have not been able to control the growth of population. During the last decade, 1991-2001, there is an increase in population by 25.00 per cent. As far as composite population densities are concerned, the upper part of the district shows low composite population densities, while the central part represents the medium level and the lower part of the district shows high level of composite population densities in all the three decades. Only Doiwala block which is located in the southern most part of the region, was under the medium grade in 1981 and 1991 but in 2001 it came in the high grade. Another aspect of socio-economic environment is urbanization. The district is divided into six development blocks

and five blocks out of six have urban population. Kalsi block is totally a rural area so this block has not been incorporated in the study of urbanization. Raipur block is the most congested, urbanized and developed because major urban centers of the district are located in this block, so this block shows high level of urbanization in all the three decades. Chakrata block is the least urbanized and developed because only one urban center i.e. Chakrata cantt is located in this block. This block lies under the low grade in all the three decades. Another block Vikas Nagar also falls in the low grade in 2001 but in previous decades it was under the medium grade. In fact, a reflection of higher levels of industrial and economic development is observed in the southern part of the district. Another aspect of the study is the tourism. The movement of people even for short duration as tourist from one place to another is responsible for impacting economic, socio-cultural and ecological set up of any locality. Excessive development of tourism in the region has begun to destroy that attributes which attract the visitors. Main tourist spots of the study area are Mussorrie, Kalsi, Lakhamandal, Sahastradhara, Dak Pathar and Rishikesh. All the tourist places attract people from various parts of the country and abroad.

The last chapter of the thesis is based on primary survey. The primary data obtained through a detailed survey confirms the findings of the secondary data. In the blocks where forests are in abundance, wood is used as fuel for cooking. Only in Kyarkuli Bhatta village about 60.00 per cent respondents were using gas as fuel. Villages which are located on the main road and close to urban centers enjoy more facilities and amenities in comparison with those villages located in the remote areas. The study confirms that the villages situated in the hilly tracks have marginal and small size of land holdings while the villages located in the plain

topography have bigger size of land holdings. For example zone I villages and Mangrauli village of zone III are located in the hilly track, while zone II villages and Dhaira village of zone III are located in the plain topography. In almost all the villages, the main source of water for agriculture is rain fed. Most of the respondents have their own agricultural implements. Mostly, farming is done by bullocks because of small size of land holdings; those respondents who have big land holdings, farming is practiced by tractors.

The socio-economic environment is represented by the variables of family size, age structure and level of education. The average size of family is 5.78, 4.36, 5.66, 6.11, 8.4 and 7.18 in Nagal Hatnala, Kyarkuli Bhatta, Harbhajwala, Lakshmipur, Mangrauli and Dhaira villages respectively. Although workforce constitutes more than two-third of the population, but most of them are theoretical workforce not actual workforce due to mass level unemployment in all the villages of the study area. Education is the most important parameter to judge the socio-economic and cultural environment in any area. Again the educational level is highest in Kyarkuli Bhatta village and lowest in Mangrauli village. Among the educated, majority are the primary literates because primary school facility is available in all the villages. The study finds a very interesting result in the house hold environment. About 75.00 per cent houses in zone I and zone II are cemented while in zone III this figure is 45.00 per cent. More vegetarians are found in Nagal Hatnala, Mangrauli and Dhaira villages while non-vegetarians are common in Kyarkuli Bhatta, Harbhajwala and Lakshmipur village. Lakshmipur village shows higher percentage of non-vegetarians because this is a Muslim dominated village. Most of the villages do not face the problem of water logging because of their location in high altitudes. Only zone II villages are located in low altitudes, some

of them face the problem of water logging, mainly the rain water, for a short period of time. The frequently reported diseases in almost all the villages are cough and cold, gastric disorder, thyroid, pneumonia, stones in gall bladder and kidneys. The major environmental problems observed in the study area are the land slides, earthquakes and the cloud burst.

The economic aspect of the study has been demonstrated by the mode employment and income level. All the villages are facing the problem of unemployment. The percentage of employment ranges between 21 and 32 in all the villages. They are mainly employed in primary sector. Only in Kyarkuli Bhatta village some of them are employed in secondary and tertiary sector. The source of income in Lakshmipur, Mangrauli and Dhaira villages is from the agricultural sector while in Nagal Hatnala, Kyarkuli Bhatta and Harbhajwala, it is mainly from non-agricultural sector.

The study reveals that all the sampled villages enjoy the school facility mainly up to the primary level and few villages have medical facility too. Drinking water facility is available in all the villages. The villages are electrified and most of them enjoy bus service facility.

The present study reveals that most of the forest cover is found concentrated in the northern part of the study area. Agricultural development is more pronounced in the upper central part of the region. The development of livestock has been recorded in the northern part of the district due to favourable ecological conditions. The highest concentration of population has been observed in the southern part of the area having a highly urbanized and developed Raipur block. The influx of tourist is recorded more in Mussorrie and Rishikesh.

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Prof. Abdul Munir
M.A.,Ph.D.
Chairman

Department of Geography
Aligarh Muslim University
Aligarh-202002, U.P., India
Phone : 91-571-2700683 (O)
91-571-2721756 (R)
e-mail:abdulmunir_amu@rediffmail.com

Dated : 10.09.2008

Certificate

This is to certify that the thesis entitled **"Ecology and Environmental Management in Dehradun District"** has been completed by **Kazma Khan** under my supervision for the award of the degree of Doctor of Philosophy in Geography.

I further certify that the work is original in nature.

Prof. Abdul Munir
(Supervisor)

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I bow in reverence to the Almighty God whose benign benediction gave me the required zeal for completion of this work.

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Kazma Khan

(Kazma Khan)

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INTRODUCTION

1.1 CONCEPTUAL FRAMEWORK

1.1(a) Concept of Ecology

When dealing with issues related to ecology and environmental management, it is beneficial, for the sake of conceptual clarity, to begin with a succinct explanation of the term "Ecology". The study of the interactions between living systems and their environment is the science of ecology. Ecology is a study of organisms in their natural home or habitat and its objective is to discover and understand the relationship between living things and their environment. The Webster's Dictionary has aptly explained ecology as "the totality or pattern of relation between organisms and their environment". It may be also defined as the interaction of organism with their chemical and physical environments (Odum, 1971).

An ecologist deals with the effect of environment on the organism, its interaction with another organism under specific environment. Autecology and Synecology are the two different fields of ecology, where individual species and biotic communities with their environmental conditions are studied respectively (Singh, 1992).

There are specialized aspects of ecology such as ecology of forest, desert, grassland, fresh water, marine water etc. But conservation, ecology, resource and pollution ecology have gained recently purposive importance for study in fact.

Basic Concepts of Ecology

Like other sciences ecology too has its own principles and basic concepts, which are as follows:

1. All living organisms and their environment are mutually reactive, affecting each other in various ways. Animal population, flora and vegetation are interdependent through the environment and are mutually reactive.

2. Environment, which is actually a complex of several inter-related factors and is much dynamic (i.e. varying with time and space), works as a sieve selecting organisms for growth from so many forms, as its one or the other factor becomes critical stages of the life cycle of the species.

3. The species put each effort to maintain its uniformity in structure, function, reproduction, growth and development by preservation of its genetic pool.

4. It is not only the environment which influences the life of the organisms, but organisms too modify their environment as a result of their growth, dispersal, reproduction, death, decay etc. Thus, the environment is caused to change due to the organism's activities. The dynamic environment and organisms make ways for the development of different kinds of organisms through a process known as *succession*. The process continues till the development of a community, which is now more or less stable and is now able to keep itself adjusted in equilibrium with the environment. The final stage of community is called a *climax*.

5. Clements and Shelford (1939), however, put forth a concept of biome wherein all plants and animals are related to each other by their coaction and reaction on the environment. According to their view, under similar climatic conditions, there may simultaneously develop more than one community, some reaching to climax stage, others under different stages of succession. This complex of several communities in any area, represented by an assemblage of different kinds of plants, animals etc., sharing a common climate, is called a *biome*.

In the above account, basic concepts of ecology have been explained mainly upon structural basis. However, with the introduction of ecosystem concept in ecology, functional aspects along with the structural ones are also to be strongly emphasized. Tanseley (1935) thus emphasized the role of environment, with its various factors interacting with each other in his comprehensive term ecosystem which involves all the non-living and living factors working in a complex manner. With this new concept in modern ecology, following are the basic concepts:

1. When both, biotic and abiotic components are considered, the basic structural and functional units of nature are ecosystems. Discrete biological units consisting of population and communities occupy a specific niche, a unique functional position with respect to other organisms with which it interacts.

2. There exists varying degrees of plus, minus or even neutral interactions among organisms, at both, inter and intra specific levels, which determine along with abiotic parameters, the degree of success a particular population has within a given habitat.

3. Also, there is involved energetics of ecosystem, as energy is the driving force of this system. The radiant energy is trapped by the autotrophic organism (producers) and is transferred as organic molecule to the heterotrophic organisms (consumers). This energy flow is unidirectional or non-cyclic.

4. The chemical components of the ecosystem move in defined cycles.

5. Successful growth of the organism is governed by limiting factors.

6. Under natural conditions, different kinds of population undergo succession. Ecosystems undergo an orderly process of change with time, passing from a less complex to a more complex state. This process changes the physical environment of a community. The terminal or stabilized state is known as the *climax.*

7. Then comes the probabilities of disruption and exploitation of ecosphere. As a result of natural condition or activities of man, species diversity of an ecosystem is reduced. Man's exploitation of ecosystems is directed towards channeling productivity to his needs. Applied ecology or human ecology is the use of ecological concepts to describe human activities and the determination of ways in which people can best attain their needs from ecosystem. Ecosystems which are substantially altered by human activities are called managed, whereas those free from such disturbances are referred to as natural. (Sharma, 2001.)

1.1(b) Concept of Environment

Environment is traditionally defined as that congeries of forces and influences acting upon an organism and in relation to which the organism is capable of reacting and in return influencing. In relation to human being, however, the environment is not one but of several kinds. Thus, man is not just an organism but a socio-ecological organism living and interacting in a bio-ecological milieu (Sprouts, 1965).

Thus, environment is an inseparable whole and is constituted by the interacting system of physical, biological and cultural elements which are interlinked individually as well as collectively in myriad ways. Physical elements determine the variable character of the human habitat, its opportunities as well as limitation. Biological elements (plant, animal, micro-organism and man) constitute the biosphere. Cultural elements (economic, social and political) are essentially man made features which go into making of cultural milieu.

The term 'environment' means everything around us, namely, the people, the flora and the fauna. Each of these affects the other and in turn all jointly affects the environment. It is well known from *Vedic* times that nature and human kind form an inseparable part of the life support system, This system has five elements, air, water, land, plants and animals, which are

interconnected, interrelated and interdependent and have co-evolved and co-adapted. Deterioration in one inevitably affects the other four elements (Singh, 1992).

1.1(c) Concept of Environmental Management

Management implies an element of conscious choice from a variety of alternative proposals and furthermore such a choice involves purposeful commitment to recognize and desire objectives. Wherever possible management implies to the deliberate adoption of a strategy or number of strategies designed to meet realistically short term objective, environmental management is concerned with the man environment interface, that complex boundary where bio-physical and socio-cultural systems interact (Hare 1970).

After the independence of the country there has been considerable progress in almost all sectors of our life and economy. Food production has increased and there has been a growth in the industrial output. Old settlements have grown and new have come into existence. Huge multipurpose projects have been constructed to supply water to the fields and generated electricity. Roads have been built connecting remote corners of the country. We have been able to transform nature with the help of technology at our command. In this mad race for progress, it has been forgotten that the natural resources were being over exploited and some of the projects were causing environmental degradation.

The main areas where the ill effects of environmental degradation are being felt are in water and air pollution, desertification and soil erosion as a result of deforestation. The process of industrialization has taken place at a rapid state and has been responsible for the pollution of water and air.

For our needs we use water from rivers, streams and other sources. It is used both for food and drink and for transportation, energy wastes disposal and so on. With the passage of time the demand of water is increasing. Industry, agriculture, irrigation, mining, power generation and the

concentration of millions of people into the cities watered by rivers, contribute to pollution. One of the greatest threats is the spread of watered borne diseases. In India 3 children under 5 die from diarrhea every minute. The disease is usually contacted from drinking polluted water. The country has a rural population of over 500 million people. Of these 98 per cent have no form of sanitations. and almost 70 per cent have no safe supply of drinking water, In order to check the industrial pollutants the government has already passed the water Act in 1974 and all the industrial projects having environmental implications are cleared after careful scrutiny. However, domestic waste is the biggest problem than the industrial effluents because the industrial waste constitutes only 10 per cent of the domestic sewage. In India the program of implementation of sewage sector is still at a low key. In Uttar Pradesh the level of pollution from domestic waste is 66 per cent while it is 84 per cent and 78 per cent in Bihar and Bengal respectively. Of the 218 cities only partial and the rest don't have any sewer system. (Amani, 1988)

As serious as water pollution is to the health and welfare of man, in many parts of the country, air pollution represents even a more serious threat to human existence. Air pollution arises from increasing automobile, truck and bus traffic and industrial growth. It has been conclusively proved that pollution is responsible for numerous respiratory diseases. Hydrocarbons discharged from bituminous coal, petrochemical manufacturing process and automobile exhaust have boosted up the rate of lung cancer and the worst affected are the children. The effects of air pollution are also felt on trees, plants and crops and on human beings. Similarly damage to property is another ill effect of pollution.

The increasing demand of energy has turned our attention to the generation of nuclear energy for peaceful purposes. It may be added here that the radioactive waste produced by today's nuclear power plants will have to be safely managed for periods longer than the whole-recorded history.

Another problem relates to desertification and soil erosion. Experiments have shown that the process of desertification is man-made and it is not the climate, which are expanding but that the land near them is itself deteriorating. Grazing by goats and other animals, remove the vegetation from the desert fringe, the soil becomes bare and ultimately converted into desert.

Plants too have suffered adversely from the onslaught of human activities. The forest wealth of the country has deteriorated at an alarming rate during the last few decades. Currently the forest cover is about 12 per cent in contrast to the National Forest Policy, which recommends that 33 per cent of the total land should be under forest. Large-scale deforestation has caused firewood famine in many parts of the country. Deforestation in the Himalayas and the Western Ghats has already created problem of land slide and soil erosion on a gigantic scale. Accelerated siltation of dams and riverbeds caused by deforestation has a most devastating effect on the ecology and economy of the country. (Amani, 1988)

Environment versus development has been an old debate and questions have often been raised whether it is possible for a country like India to have or even want to have both environment and development and the environmental protection is not a luxury. The environmental debate has turned away from a conservation viewpoint to that of a development one because good environmental management is essentially good as whom do resources benefit in society? Whom does the current resources consumption and utilization pattern benefit most? These are political questions but with major environmental implications. Are forest, for instance, a resource to meet the need of the forest people or a few rich contractors who wants to meet the demands of rich people living in urban areas? Are river resources for the people who drink water from it and earn a living by fishing in it or are they cheap dump yards for urban and industrial India to get rid of its waste without caring for the village downstream?. It should be realized that in a poor country like India environmental damage is usually a consequence of poverty. It is because they

have no other fuel with which to cook their food that people fell trees and with dungs, they overgraze the poor pastures because they must eat and make a living. Now if there are people who blame the poor farmers for destroying the trees and nomads for over grazing the pasture they are expecting an unreasonable sacrifice. They in effect are inviting the poor to die so that the plants and grasses can live. It would be absurd and immoral. The protection of non-humans must follow the protection of humans for there is no other way in which it would be achieved. The two goals are inseparable and environmental protection of non-humans must follow the protection of humans for there is no other way in which it would be achieved. The two goals are inseparable and environmental protection has an economic, social and political aspect (Amani, 1988).

Environmental management attempts to integrate natural and social system for the benefit of the latter and without being detrimental to the stability of the former. Environmental management is proper, natural and scientific resource use and management. It therefore calls for an interdisciplinary approach to the problem of resource utilization and their recycling. The central theme of environmental management is thus the reduction or minimization of the impact of human activities on the physical and ecological environment.

According to Pal (1982) there is need for rapid and intensive development of many kinds to ensure a better quality of life for the people. But this has to be done without undue damage to the environment so that its capacity to support life is not unduly impaired. No knowledgeable person will say that there must be no development and that the environment must remain exactly as it is.

Many conservationist fear that it has taken so long to become aware of the need for wise environmental management based on the principles of ecology that the best we can hope for now is to prevent further disruption of natural ecosystems and resource exploitation and environmental pollution (Khoshoo,1980).

Thus man is firmly located as a part of global ecosystems, which depend on him much as he depends on it even though the viewpoint of the environmental management process is fundamentally that of man, whose decisions determine whether he himself or even the rest of the global ecosystem will survive at all.

If man is prepared to limit growth and settle for condition of economic and ecological stability, population should be established by equalizing birth and death rates. Industrial growth must stop except to replace old facilities. Behavioural pattern must change and man must learn to prefer services, such as education and recreation, to material goods. For what use is it, if in promoting economic growth, man creates an environment, which is not a joy to live.

Objectives of the Environmental Management

The objectives of the environmental management are so varied as each individuals or group values, perceptions, needs and preferences. The objectives of comprehensive environmental planning has traditionally been separated into three areas; the protection of physical and mental health, the enhancement of economic values and the preservation of sensory and participatory pleasure. It is to be life supporting, it is to be useful and it is to be beautiful (Kates, 1969), (*Styam, Shivam and Sundaram*). The objective is often generalized as the maintenance of environmental quality a term which is interpreted differently by different people, ranging from 'zero population growth' simplicity of life and eradication of poverty for decent human existence and from the survival of human species, to an environment that not only sustains life but enriches life, harmonizing the works of the man and nature for the greater good of all (Mikesell, 1974).

Approaches to Environmental Management

There are two approaches to environmental management; preservative and conservative. The first approach pleads for non-interference in physio-biotic world and complete adaptation by man to it. Adaptation is treated here in

the more restricted sense of tolerance, where stress is recognized but in the short terms at least is accepted with no alternation to an existing way of life. The second approach, on the other hand, leaves room for man's adjustment with physio-biotic environment. Adjustment involves some kind of positive and deliberate reaction usually aimed at reducing the impact of the noxious element and is therefore, homeostatic in nature (Riordam, 1971).

1.2 DETERMINANTS OF ECOLOGY AND ENVIRONMENT

Biota (flora and fauna) of a particular habitat differs from the other. Factors which limit the species of a particular habitat are called as environmental factors. They are responsible for the growth, distribution, abundance, behaviour and ultimate survival of the organisms. Physical and chemical factors collectively form the non-living or abiotic environment where as living or biotic environment includes interrelationships with other populations for food, shelter, energy etc. Moreover, there exists an overlapping mechanism between abiotic and biotic factors effective for a particular population in concomitance with time and space.

A population is collectively exposed to these factors. However, some factors exert more influence than the others. A study of their relative influences has led to the development of certain laws and principles pertaining to limiting factors.

Any factor that tends to slow down the rate of metabolism or potential growth in an ecosystem is said to be a limiting factor. However, a factor that controls the survival is said to be a regulated factor. The success of a population or community depends on many factors. Any condition that approaches or exceeds the limit of tolerance for the organism may function as the limiting factor. Although quantity and quality of incoming energy and the laws of thermodynamics set the ultimate limits, different ecosystems have different combinations of limiting factors that may put further limitations on biological structure and function (Rana, 2003).

The climatic elements upon which plant growth depends are temperature, rainfall and duration of sunlight. The edaphic factors are related to soil characteristics, i.e., soil texture, profile, humus, nutrients, etc. All of these factors have a role in the growth and development of plants. Soil acts as the medium of moisture supply which plants need during the period of growth.

The activity of separate environmental factors such as temperature above the maximum will sooner or later result in a cessation of all manifestations of life. Benecke and Jost (1923) have attempted to show the effect of length of exposure to given temperature on the location of the optimum condition. The rate of activity of Lepidium Sativum exposed to the temperatures indicated for the intervals of 3.5, 7 and 14 hours were measured by the increased in the length of the roots. A short exposure of 3.5 hours showed an optimum temperature at 30°C, with the doubling of the time interval the optimum was found at 29°C and when the period of exposure was lengthened to 14 hours, the highest rate of activity was at 27.2°C.

In short, the living organisms are influenced by the environment in a number of ways. These environmental or ecological factors govern the survival and growth of life cycle. The responses of the organisms to their environment are governed by the following ecological laws:

1. Liebig's Law of Minimum

A German botanist Liebig (1840) proposed that the essential material available in minimum amounts most closely approaching the critical minimum would tend to be limiting, a concept that is known as Liebig's law of minimum. It shows, that the growth of plant is dependent on the amount of nutrients that are available in minimum quantity. Therefore, he came to the conclusion, that the growth of plant is limited by the essential nutrients which are in short supply in relation to the needs of the plant. In other words, if any essential nutrient is present only in minimum quantity in relation to the needs of the plants, the growth of the plants would be restricted to the minimum.

Liebig, visualized primarily in terms of light, temperature, nutrients and essential elements. He tried to explain the absence of some plants in shaded areas or lack of vegetation above certain altitudes in the Alps. He gave justification of plant distribution in terms of inadequate light, temperature or nutrients. He suggested, that the crop yields are not often limited by nutrients but by others which are needed in minute quantities and are in short supply, such as zinc. Although the general concept of Liebig's law has been well accepted, but it has also been criticized, as he did not attempt to develop the concept of length that they might too much of these factors as well as too little, is strictly applicable in steady state conditions only. Action of these factors other than the minimum one may modify the rate of availability and utilization. In some plants zinc may act as a limiting factor only when grown in sunlight since these plants require less zinc when grown in shade than in full sunlight.

II. Schimper's Optima

Schimper (1903) coined three terms which can be used for the purpose of illustrating the reactions of plants to increasing intensities of a particular factor of the environment. These terms are the "absolute", "hamonic", and "ecological optima". These optima may be taken in a broader sense than the previously considered cardinal points and their meanings can be expressed as :

The absolute optima correspond to the highest degree of activity of any one function of a plant such as transpiration or respiration. With increasing temperatures upto a certain point, plants allow to transpire at given intervals ever-increasing amount of water. Beyond this point, because of interference or of the break down of certain of the intricate portions of the organism, the rate of activity decreases sharply. The absolute optimum point of activity may, therefore, be defined as that point where limiting factors or checks come into activity.

The harmonic optimum corresponds to the most favourable intensity of any one function in relation to the other functions of the plant. While

transpiration is a necessary function of the plant, an excessive activity of this particular or of any other, function would soon lead to the destruction of the plant. The plant reaches its highest activity at that particular point where the rates of activities of the various functions are in harmony with each other or at that point where they are properly coordinated.

The theoretical ecological optimum consists of the summation of various harmonic optimums while locating the average point of ecological optimum, it is necessary to consider the relative importance of the various functions of the plant in their relation to the growth and behaviour of the entire organisms. Because, it is difficult to give the exact location of the summation of the various harmonic optima or the exact location of the ecological optimum.

III. Shelford's Law of Tolerance

Shelford (1913) initiated the concept of limiting factors to include the limiting effect of maximum as well as minimum. He proposed that, a factor may be limiting not only at low quantities, but too high quantities of the factor may also be detrimental to the growth and development of the organism. Thus, any environmental factor which is below the critical minimum or well above the critical maximum would limit the growth of organism in a given area. This is known as Shelford's law of tolerance.

Organisms have ecological maximum and minimum requirements for each environmental factor. These are the limits of tolerance for the organism with reference to that factor. Various environmental factors do not influence the organisms independently. The effect of one factor is modified by the other and hence the organisms respond to the totality of the environment. According to the law of Tolerance, every environmental factor has two distinct zones: (i) a zone of tolerance, and (ii) a zone of intolerance.

(i) A Zone of Tolerance:

This zone is favourable for the growth and development of organisms. It is composed of three parts:

(a) Optimum zone:

This zone is the most favourable to the organisms where growth and development are maximum.

(b) Critical minimum zone

This is the minimum limit of any environmental factor beyond which the growth and development of the organism ceases.

(c) Critical maximum zone:

This is the maximum limit of any environmental factor beyond which the organisms usually cease their normal activities.

(ii) A Zone of Intolerance:

This zone is well below the critical minimum and above the critical maximum. This zone is unfavourable for the growth and development of the organism and they cannot survive and tolerate for a long period. (Hussain,2003)

Still there are some subsidiary principles to the law of tolerance as mentioned below.

a) Organisms have a wide range of tolerance for one factor and a narrow range for another.

b) Organisms with wide range of tolerance for all factors are likely to be most widely distributed.

c) When one ecological factor is not optimum for a species, the limits of tolerance may be reduced with respect to other ecological factors.

d) Organisms often adjust their rate functions to local conditions.

e) Organisms some times do not live at the optimum range with regard to a particular physical factor. In such cases, other factors exert an important influence.

f) Environmental factors are more limiting during the period of reproduction. The limits of tolerance for the reproductive individuals,

seeds, eggs, embryos, seedlings and larvae are usually narrower than for non-reproducing adult plants or animals.

It has been found that all possible factors are not equally important in a given situation or for a given organism. Moreover, physical environment may also exert important controlling influence not only by limiting but triggering the activity of organisms (Hussain, 2003).

1.3 THE STUDY AREA

The district of Dehradun, extending between 29°58' to 31° 2'30" North latitudes and 77°34'45" to 78°18'30" East longitudes, covers an area of 3,088 sq.km. Uttar Kashi, the east of the twin districts of Uttar Kashi and Tehri Garhwal, surrounds it on the north. In the south lies the district of Saharanpur of Uttar Pradesh and its extreme southern tip touches the boundary of Bijnor district of Uttar Pradesh. The district stretches in NW-SE direction following the main Himalayan trend. This provides one of the most fertile lands for agriculture. The holy river Ganga and Yamuna makes its eastern and western natural limits which follow the fault lines across the Siwaliks. The region enjoys sub-tropical to sub-temperature climate. The year is divided into four climatic seasons i.e. hot weather season, monsoon season, transition season and cold weather. The average annual rainfall of the district is 2073.3 mm.

The agricultural sector in Dehradun district provides 21.8 per cent of the working population. Forest occupies 65.36 per cent of the total reported area of the district, while the land not available for cultivation occupies 5.56 per cent of the total area of the district. Other uncultivated and fallow land occupies the remaining area of the district. The district covers 16.52 per cent area under cultivation. The agricultural year is divided into three main seasons; *kharif* which correspondence to rainy season, *rabi* which correspondence to winter season and *zaid* corresponding to summer season. The major *kharif* corps are rice, maize, pulses and sugarcane, while wheat, oilseeds and vegetables are the main crops of *rabi* season. Only certain vegetables are

grown in *zaid* season. In fact wheat and rice are predominant crops of the district. The district supports a population of about 12, 82,143 persons with an average density of 415 persons per square kilometer. Substantial part of the population is engaged in agricultural activities either as cultivators or agricultural labourers. The average literacy rate of the district is 68.36 per cent with 74.36 male literates and 61.58 per cent female literates. The district is inhabited by the people of different caste and creed; Hindus account 84.71 per cent while Muslim and Sikhs account 10.85 and 2.60 per cent respectively of the total population.

1.4 STATEMENT OF THE PROBLEM

Defence and preservation of the environment is one of the most pressing problems of our time. Today we have reached critical points in several areas of man's impact on nature. The progressive development and the very existence of modern civilization depend upon a constructive solution of the problem of man's relation with his habitat.

Today's ecological problems are rooted in the determination of national environment through industrialization and urbanization of man's mode of life, exhaustion of tradition energy and raw materials resources, constant growth of demographic pressure on nature, disturbances of natural ecological equilibrium, the economic elimination of individual species of plants and animals, the negative consequences of pollution of nature by waste of economic activity etc.

The alarming and dangerous sign of ecological crises and degradation of our planet's biosphere through the impact of mounting activities of man is forcing the world's scientific community to seek a way out of the situation unwillingly created and to revise the very concept of rationality in our effects of nature.

The present study "Ecology and Environmental Management in Dehradun District" aims at identifying the effect of anthropogenic interference on forestry, mining, agriculture and land use practices, livestock,

industrialization and urbanization tourism, demographic pressure and also to find out how far they are effective in bringing about ecological imbalances. Suitable ecological basis of environmental management has also been incorporated in the study.

A key to a cardinal solution lies in an understanding of the nature of the ecological balance in terms of macro and micro ecosystems and a planned management of environmental resources on a truly rational and scientific basis.

1.5 OBJECTIVES

The present study has been conducted:

1. To explain the concept of ecology, environment and environmental management as well as determinants of ecology and environment.
2. To study the geographical background of Dehradun district, its geology, relief, drainage system, climate, flora and fauna etc.
3. To examine the spatio-temporal distribution of natural, genetic and socio-economic environment.
4. To assess the different issues and problems related to the ecological and environmental resources.

1.6 DATABASE AND RESEARCH METHODOLOGY

Every science gradually accumulates a body of methodological lore that becomes a part of its organized body of knowledge. Moreover, it is necessary for each discipline to define its basic concept in terms that make quantitative analysis possible. A rigorous analytical research must have its hypothesis defined and its methodology developed area by area and culture by culture.

1. Data Base:

The study is based on the analysis of statistical data covering the period during 1981 to 2001 for the analyses of ecology and environmental

management, collected from both primary and secondary sources at village and block levels. The primary data were collected through well prepared questionnaire, taking into account of all the variables related to ecology and environmental condition. The village level information was collected from the selected respondents and Gram pradhan (Village Head), Sarpanches and Gram Vikas Adhikaries (Village Development Officers).

The secondary data for the geographical background of the area including climatic parameters of temperature and rainfall, soil and vegetation, general land use, agricultural land use, demographic pattern, social structure, different agricultural inputs and outputs have been obtained at national, state and district and community development block levels from various government organizations. Although it would be time and spaces consuming to mention all the publications, the following ones are important and worth mentioning:

a. Meterological data have been collected from the Indian Meteorological Department, Lodhi Road, New Delhi and also from the Statistical Abstract of Dehradun District.

b. Statistical Abstract of Dehradun District 1981, 1991, 2001, Uttaranchal.

c. Census of India 1981, District Census Handbook, Dehradun District..

d. Census of India 1991, Uttar Pradesh published by Directorate of Census Operation, Uttar Pradesh.

e. Census Operation, 2001 Uttaranchal published by Directorate of Census Operation, Uttaranchal.

f. State of Forest Report 2001, Forest Survey of India published by Ministry of Environment and Forest, Dehradun District.

In order to reach standardization, the raw data for each variable has been computed into standard scores. It is commonly known as 'z' score. The scores measure the departure of individual observation from the arithmetic means of all observations, expressed in a comparable form. This means it

becomes a linear transformation of the original data. This method was first used by Smith in 1968 in his study on inequality in Peru followed by D. Smith (1973) and D. Slater (1975). The formula involved is:

$$Zi = Xi - \overline{X} / S.D$$

Where, Zi is the Standard Score,

Xi is the Original or individual value for observation i

$\overline{X}$ is the mean for the variable,and

S.D is the standard deviation (δ)

The standard score additive Model has been used to develop a composite economic and social indicator for each set of variables and a general indicator including all criteria of variables.

All social indicators and economic indicators require the addition of Z-Score for the individual variables. The model is thus:

$$Ij = \sum_{i=1}^{K} Zij$$

Where Ij is the magnitude of indicator for district j. Zij is the standard score on variable (i) in the district j, k is the number of variables measuring the criteria in question (Smith,1973). District scores on different indicators can thus be directly compared, irrespective of the number of variables contributing to them. The overall general indicator of social and economic (SEI) for any district will be

$$SEIj = \sum_{i=1}^{n}$$

Again these results can be transformed back into Z score, so that 'Zero' indicates average performance and unity (+ or -) represents one standard deviation in either direction.

Further, the results of the standard score obtained from the different indicators were aggregated in order to find out the Composite Standard Score

(CSS) so that the regional differences in the levels of development of various blocks may be obtained on a common scale (Shafiqullah, 2000).

The inter block variations are grouped into three grades of high, medium and low level with the help of their standard deviation from the mean. The advanced cartographic and GIS techniques have been used to show spatio-temporal variations in the study area.

1.7 A REVIEW OF AVAILABLE LITERATURE

A healthy ecological balance is necessary for the survival and development of living things. The increase in pollution which is hazardous for the existence of living things caught the attention of many researchers from different disciplines. The scholars studied the causes of pollution and impacts of human activities on the ecological conditions in their own way.

The extent of studies done on different aspects of ecology and environment is so vast that they cannot be recorded because of spatio- temporal scarcity. Therefore, an attempt has been made to review some of the important works concerned with ecology and environmental management.

Prasad, H. (1977), has applied a method for studying regional land use ecology of Dehradun, and undertakes a case study of the environs of the Songsusma confluence in East Dun. Taking the village as revenue unit, the study is based on revenue records, forest reports and field traverse.

Saha, P. (1982), has dealt with the status of forestry in the U.P. Himalayas and its impact on ecology. The social forestry program has been recommended for protecting the forest canopy to restore the ecological balance in the Himalaya. The functional linkage between the social forestry programs and the state forestry program has also been identified.

Kumar, P. (1983) has attempted to explain the functional analysis of Dehradun Urban Complex. It is based on the study of nature, mode, type and

distribution of five main urban functions i.e. industry, construction, trade and commerce, transportation, storage and communication and other services.

Nag, P. (1983), has discussed the perception of the environment: Issues and Challenges. The study in relation to man can be put into two contemporary phases of the environmental coin; one is the influence of the environment upon man, the other is man's influence on the environment. The study of environment indicates the multifarious nature of this science.

Pal, D. and Sah, S.C.D. (1984), have analysed and correlated the Doon Environs: Its Geological Setting, Mineral Wealth and Land Use. The entire study is based on the secondary data. Two sub-catchments of Asan and Song perennial rivers and huge number of natural springs form Dun valley provides one of the most fertile lands for agriculture because of it's geomorphic features. There is abundance of economic minerals like limestone, limestone marble, Phosphate and gypsum.

Yadav, R.S. (1984), has dealt with environmental problems and Eco-development: Sub regions in south Mirzapur. This region has suffered due to several ecological problems associated with the development process. The unplanned development activities and tendency of maximum exploitation of resources at minimum cost caused ecological imbalances.

Mookherjee, S. (1986), has correlated the Ecology and the tribals: a process of human adjustment with environment. The tribes and non-tribes have developed a social cohesiveness over the countries and a symbiotic relationship between them now exists. A growing awareness has emerged for preservation of both environment and culture. Therefore any future planning and development should concentrate on conservation of tribal mode of living modified by new technological efficiencies.

Misra, R.P. and Misra, H.N. (1987), have given a detailed account of Human Survival and Development: Focus on land, water and minerals. In this paper an attempt has been made to highlight the importance of natural

resources such as land, water and mineral resources to human kind in their survival on this planet. The authors have posed this problem in the contexts of the impending ecological crises. The study ends with reflections on science and technology education.

Amani, K.Z. (1988), in his paper Ecology and Development has focused the role of technology in the transformation of the natural environment. The main areas where the ill effects of environmental degradation are being felt are in water, air pollution, desertification and soil erosion as a result of deforestation.

Melkania, N.P. and Melkania, U. (1988), have made an attempt to analyze, the Himalayan environment at the ecosystem level. The study is based on personal observation and studies, and information available in the literature. Environmental problems of Himalaya can be controlled by providing education and scientific practices for resource management and utilization and appropriate alternatives to the inhabitants as per their socio-economic status and ecological conditions of the region.

Patil, V.K. (1988) has discussed that the agriculture is the oldest and the most widely practiced profession of man and hence it is essential for us to know its consequences on the ecosystem and the repercussions that arise as a result. Agriculture is an effort by man to shape his environment to suit his needs better.

Singh, R.B. (1988), in his paper 'Environment and Development', A search for an integrated strategy, has outlined the changes in the paradigms of development during the last three decades, laid out the concept of sustainable development, identified the essential elements of a viable model of sustainable development strategy that may ensure growth with equity and environmental sustenance.

Tiwari, P.C. (1988), has dealt with the Kumaun Himalaya: Land use systems and Environmental Degradation. The aim of this paper is to measure

the relationship between the changing pattern of land use and soil erosion in the Shail Gad watershed in the Kumaun Himalaya on the basis of hydrometric, morphometric and anthropogenic parameters. A correlation analysis was done to test the relationship between various variables.

Singh, R.L. (1989), goes on to discuss the ecological implications of landscape and human welfare. The most critical problem discussed very widely at global scale is concerned with the environmental and ecological balance with a view to promoting harmonious, peaceful and quality of life for the human being.

Pratap, D. and Qureshi, M.H. (1990), have analysed the forest resource development strategies and the forest movements in U.P. Himalaya which are concomitant because the starting of forest management and the resultant control by the state on larger areas has generated the conditions for people's forest movements.

Shafi, M. (1991), has correlated environmental pollution and global environmental change. It will be seen that development is related to environment. Environment today is under great stress and it is largely because of man's own making.

Mohammed, N. and Bandooni, S.K. (1992), have given a detailed account of monitoring of land use and agriculture. There is a need of agricultural and land use data for its proper understanding, monitoring and rational planning. With this view, Pauri Garhwal district of the Garhwal Himalaya has been taken for understanding the pattern of land use and evaluating the dynamics of land use with particular reference to agricultural land use. The study is entirely based on secondary data for the year 1975-76 and 1985-86.

Pant, R.B. and Jalal, D.S. (1992), have dealt with the study of carrying capacity of land resources in central Himalaya that revealed heavy pressure of both human and livestock population.

Parikh, J. and Shukla, V. (1995), have dealt with urbanization, energy use and greenhouse effects in economic development. In their work they sought an exploratory assessment of the possible global greenhouse consequences of economic development in general and urbanization in particular, especially in so far they relate to changing patterns of energy use. It presents some of the implications of the results for policies toward urbanization and energy strategies for developing countries in the context of global environmental management imperatives.

Barrow, C.J. (1995), has presented an overview of global environmental problems, past, present and future and examined their roots and implications and suggested ways in which they might be mitigated or avoided by careful management and a reconsideration of unsound ethics or concepts of development.

Piel, G. (1995), has discussed on environment and development. This section includes four papers addressing specific issues concerning socio-economic development and the environment.

Sircar, P.K. (1996), has explained the environmental laws. Environment is a system of interaction between the natural system and the social system and as such is subject to the dialectic of environmental laws and human laws.

Pratap D. and Qureshi, M.H. (1996), have noticed that anthropogenic intervention have resulted in changes in terms of coverage as well as composition of the forest in U.P. Himalayas. Substantial changes have occurred in different phases as a result of agricultural expansion and increase in livestock population at local level and large scale extraction of timber for outside use.

Singh, O.P. (1996), has attempted to explain the growth of population in U.P. Himalaya in temporal-spatial perspective and in the light of existing environment and associated factors such as over all population growth, internal

variation of growth, role of migration; growth types associated factors and environment.

Mannion, A.M. (1998), has dealt with the Global Environmental Change: the causes and consequences of disruption to biogeochemical cycles. Such cycles link the lithosphere, biosphere and atmosphere with in reciprocal relationships. These relationships have been profoundly altered by human activity but remain reciprocal.

Basu, S.R. (1998), has given a detailed account of mining and environment taking few case studies in the Eastern Himalaya. This paper calls for attention of the effects of the unscientific quarrying operations in the coalfields of the Lish Basin and the Dolomite mines of the Upper Jainti Basin in the Eastern Himalaya.

Chakraborty, S.C. (1998), has discussed the Geographer's approach to environmental management. Geographer refers to the processes operating over larger territorial units to explain the manifest attributes to environment of any given place at any given time.

Reddy, G.P.O. and Rao, M.S. (1999), have analyzed "the Environmental Impact Assessment of Anantpur District". Their study is based on the physical and natural resources of Anantpur District using Landsat Thematic Mapper (T.M.) band 5 and 7 and IRS-1A(LISS-1) FCC's data on scale 1:250,000. The EIA index of the district has been worked out with the help of natural and physical resources, urbanization and industrialization data. The EIA index values reveal the ill effects of our exploitation of natural resources and environmental degradation in the district. This study is highly helpful for further optimum utilization, conservation and management of natural and physical resources and environmental management of the district.

Ward, D., Phinn, S.R. and Murray, A.T. (2000), have discussed "Monitoring Growth in Rapidly Urbanizing Areas Using Remotely Sensed Data". Data models for establishing the range of urban land cover types and

their biophysical composition (vegetation, soil and impervious surfaces) are integrated to provide a hierarchical approach to classify land cover within urban environments. The first stages of approach have been applied to examine urban growth between 1988 and 1995 for a rapidly developing area in Southeast QueensLand, Australia. Lands at Thematic Mapper Image data provided accurate classification of broad land cover types and their change over time. Models highlight an important application for current and next generation moderate spatial resolution image data in studies of urban environment.

Romero, A.G. (2001), in his work "Evolution of disturbed oak woodlands; the case of Mexico City's western forest reserve" has focussed geo-ecology of the climax oak woodlands found in the Sierra delas Cruces. Based on morpho-structural evidence, bio-climatic type, degree of human intervention and general geo-ecological considerations, three territorial systems have been differentiated in which the oak woodland exist in different climax faces. A comparative study of the content, structural and functional relationships of the secondary faces associated with these climax communities, allowed conclusion to be drawn respond to human intervention, and the risky situations to which these communities are subjected particularly the most sensitive faces that deserve immediate protection.

Czaya, S. (2001), has analyzed the influence of "Mining on hydrological transformation in Upper Silesia from the 15^{th} to the 19^{th} century". The perturbation of local hydrological conditions began in the 15^{th} century as a result of wider scale mining of Iron, Silver and Lead ores. Further changes took place during the 16^{th} and 17^{th} centuries, following the application of gravitational main drainage. As a result, a compact cone of depression, covering an area of about 3 sq.km. was created. In the 18^{th} century, the activities of mills, sawmills and smelters caused considerable changes in the surface river network and created the so-called anthropogenic, Upper Silesian Lakeland. At the end of the 18^{th} century, underground mining activity was

renewed and as a result the area of the compact cone of depression increased to 10 Sq.km. and its depth reached to 50 meters.

Dutta, P.C. (2002), has dealt with the Development of Social Forestry in Assam of North Eastern Region. This paper is an attempt to reinterpret the concept of social forestry in the context of NER. Care has been taken to analyze the extent of the development of forestry in general and social forestry in particular by collecting statistical data from different secondary sources. The findings of the paper are that the forestry in this region is on the decline due to different known factors. Hence the study needs elaborate suggestions for the development of social forestry in the region.

Pant, P. (2003), has discussed various problems related to infrastructural and recreational amenities as observed by the tourists in Nainital, which is an important lake resort of northern India, lying in southern lesser Himalayas.

Allen, A. (2003), has argued that environmental planning and management of the peri-urban interface cannot simply be based on the extrapolation of planning approaches and tools applied in rural and urban areas. Instead, it needs to be based on the construction of an approach that responds to the specific environment, social, economic and institutional aspects of the peri-urban interface. The paper also outlines approaches to environmental planning and management in the peri-urban interface, examining its specificity in terms of both the challenges faced and possible approaches for implementation.

Bhattacharya, S. (2004), this paper focuses on the issues emanating from the imbalance and uneven urban population growth and its effect on environmental degradation. The skewed pattern of urbanization leads to acute stress on environment, quality of life and basic services.

Munir, A. et al. (2005), have analyzed the spatial distributional pattern of forest in Uttarkhand. The study has been conducted on the basis of secondary sources of data. The study reveals that the forests are mostly

concentrated in the southern part of the region and sparsely distributed in the northern and eastern part of the study area.

Guha, M. and Chattopadhyay, A. (2006), have studied the linkages between developmental parameters, population dynamics and forestry in the north-east India. It is observed that the benefits of planned development in the region have been offset by rapid population growth in many of the states and only a marginal part of the development contributes towards improving the existing indices of development.

Munir, A. et al. (2006), have given a detailed regional pattern of urbanization in Dehradun district. The pattern of regional variation of urbanization is much similar to that of the urban population to rural population and the distribution of the urban centres. In fact a reflection of higher levels of industrial and economic development is observed in the southern blocks of the study area.

Ali, J. and Mustaquim, M. (2007), have analyzed the growth of urban population and trends of urbanization in North Bengal. The data analysis indicates that there is a lot of spatio-temporal variation in urbanization in North Bengal. The level of urbanization is characterized by gradual decrease from north to south districts.

1.8 CHAPTER DESIGN

The present research work unfolds the various aspects of ecology and environmental management in Dehradun district both in, time and space. The whole study has been divided into seven chapters.

Chapter first is an introductory chapter dealing with the conceptual framework of ecology, environment and environmental management as well as determinants of ecology and environment, geographical base of the study area. Besides, statement of the problem, aims and objectives, hypotheses, review of selected works, database and methodology have also been discussed.

The geographical profile of the study area has been described in chapter second which deals with (a) physical profile, (b) economic profile, (c) social profile. The study area embodies a distinct geographical personality in terms of physiography, climate, natural vegetation, soil and water bodies.

The chapter third deals with suitable ecological basis of environmental management.

Chapter fourth describes the natural environment in terms of forests and mining.

Chapter fifth is devoted to the study of genetic environment. This chapter incorporates the study of agriculture and livestock.

The socio-economic environment has been dealt in sixth chapter. This chapter has been divided into three parts, namely, demographic setting, urbanization and tourism.

Chapter seventh is devoted to the ecological profile of the sampled villages. This chapter is based on primary survey. It comprises of various variables related to natural and genetic environment, socio-economic environment, household environment, mode of employment and income level and infrastructural development.

In the last, the conclusion and summary are given. However, some measures have also been suggested for the improvement of ecological and environmental conditions in the study area.

Chapter 2

Geographical Profile of the Study Area

Chapter – 2

THE GEOGRAPHICAL PROFILE OF THE STUDY AREA

The Geographical personality of a region has a strong bearing on the socio-economic and functional structure of the population. It affects the personal and household characteristics of the people, their physical and human attributes, farming and agricultural productivity, utilization of the latest techniques and machinery in the field of agriculture and the overall development of the region. Therefore, an account of the physical, economic and social framework of the area is necessary.

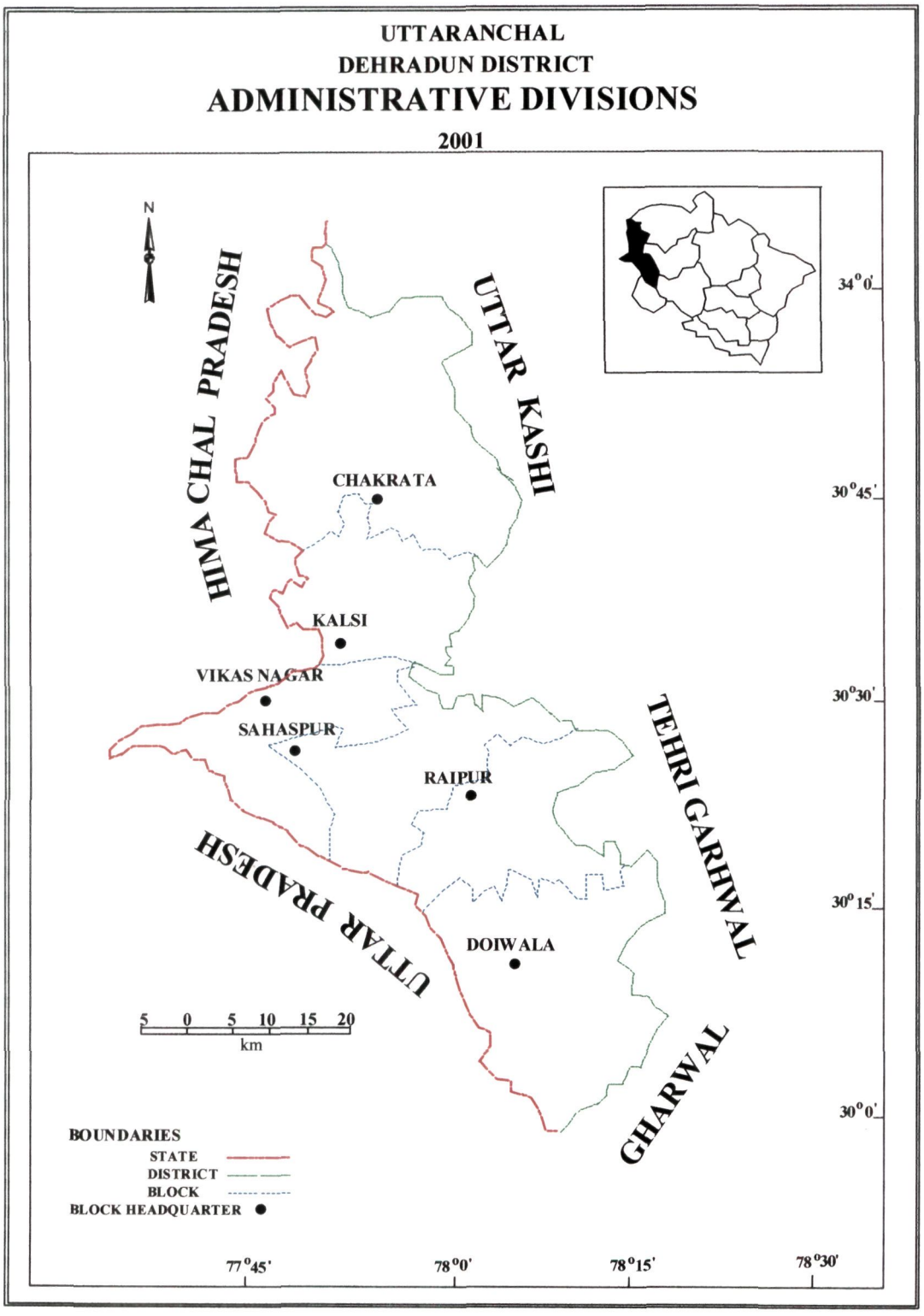
2.1 PHYSICAL PROFILE

The district of Dehradun is located in the northwest region of the state Uttarakhand. It is surrounded on the north by Uttar Kashi, the east by the twin districts of Uttar Kashi and Tehri Garhwal. In the south lies the district of Saharanpur of U.P. and its extreme southern tip touches the boundary of the Bijnor district. Seen from Mussoorie the country around Dehradun appears to be well wooded especially at the southern extremity of the town.

Nestled in the mountain ranges of the Himalaya, Dehrdun is one of the oldest cities of India and is recently declared as the provisional capital of the newly created Uttaranchal state in the month of November 2000.

The name Dehradun is a combination of two words, 'Dehra and Dun'. The former is a corrupt form of 'Dera', which signifies a temporary abode or a camp. The term 'Dun' means lowland at the foot of a mountain range. As the bulk of the district lies in such a tract, the 'dun' part of the name is fully justified.

According to the central statistical organization the area of the district was 3,088 sq.km. in 2001. It lies between 29°58' to 31°2'30" north latitudes and 77°34'45" to 78°18'30" east longitudes at an altitude of 640 mts (2100 ft)



Source : Regional Office, Census of India, Dehradun District, Uttaranchal

Fig. 2.1(i)

above mean sea level Figure 2.1(i). The district comprises four tehsils (Chakrata, Vikas Nagar, Dehradun and Rishikesh) and six blocks (Chakrata, Kalsi, Vikas Nagar, Sahaspur, Raipur and Doiwala).

2.1(a) Physiography

The district comprises of two distinct sub divisions:

1. The Montane Tract
2. The sub-Montane Tract

The Montane Tract

It is roughly oval in shape with its major axis lying north and south. It consists of a succession of mountain and gorges and comprises of Jaunsar Bawar, the hilly *pargana* of the district. The most distinct feature of this tract is a ridge separating the drainage basin of the Tons from that of the Yamuna. The mountains are peculiarly rough and precipitations with few villages, making cultivation small and tedious. Presence of limestone gives it a massy and irregular character. The ravines are deep and sudden in their descent.

The Sub Montane Tract

Herein lies the Dun proper, which is an open valley bounded by the Siwalik hills in the south and the outer scarp of the Himalayas in the north. The Dun is an irregular parallelogram in shape with its longer axis lying northwest and southeast, and its existence as such is due to the presence of the Siwalik Hills as well marked range extending along the entire southwestern holder of the Dun.

2.1(b) Mountains

Dehradun comprises of the Himalayas and the Siwalik ranges. The term "Himalayas" means the range covered with eternal snow which the word 'Siwalik' was considered equivalent to 'Sawalakh' i.e. to say of 1,25,000 peaks.

1. **The Siwaliks:** They extend along the entire southern border of the district from the Yamuna to the Ganga, running parallel to the Himalayas. They consist of sharp, towering peaks nearly perpendicular precipices and a maze of little valleys. At the extreme southeast corner of the district where the range is pierced by 'Ganga' it expands into a mountain knot known as the Motichur hill. A number of long and high ridges run out in every direction, assuming a direction parallel to the main ridge. The Siwalik range is of a recent formation and is perhaps the most recently formed range of similar magnitude on the earth.

2. **The Himalayas:** On the north and north-east the horizon is rounded by the Mussorie range, which binds back and encloses a portion of the valley in an immense amphitheatre. This range forms here the outer scarp of the Himalayas system and culminates in the landour peak and Top Tibba. To the south, a number of minor ridges run towards the Dun.

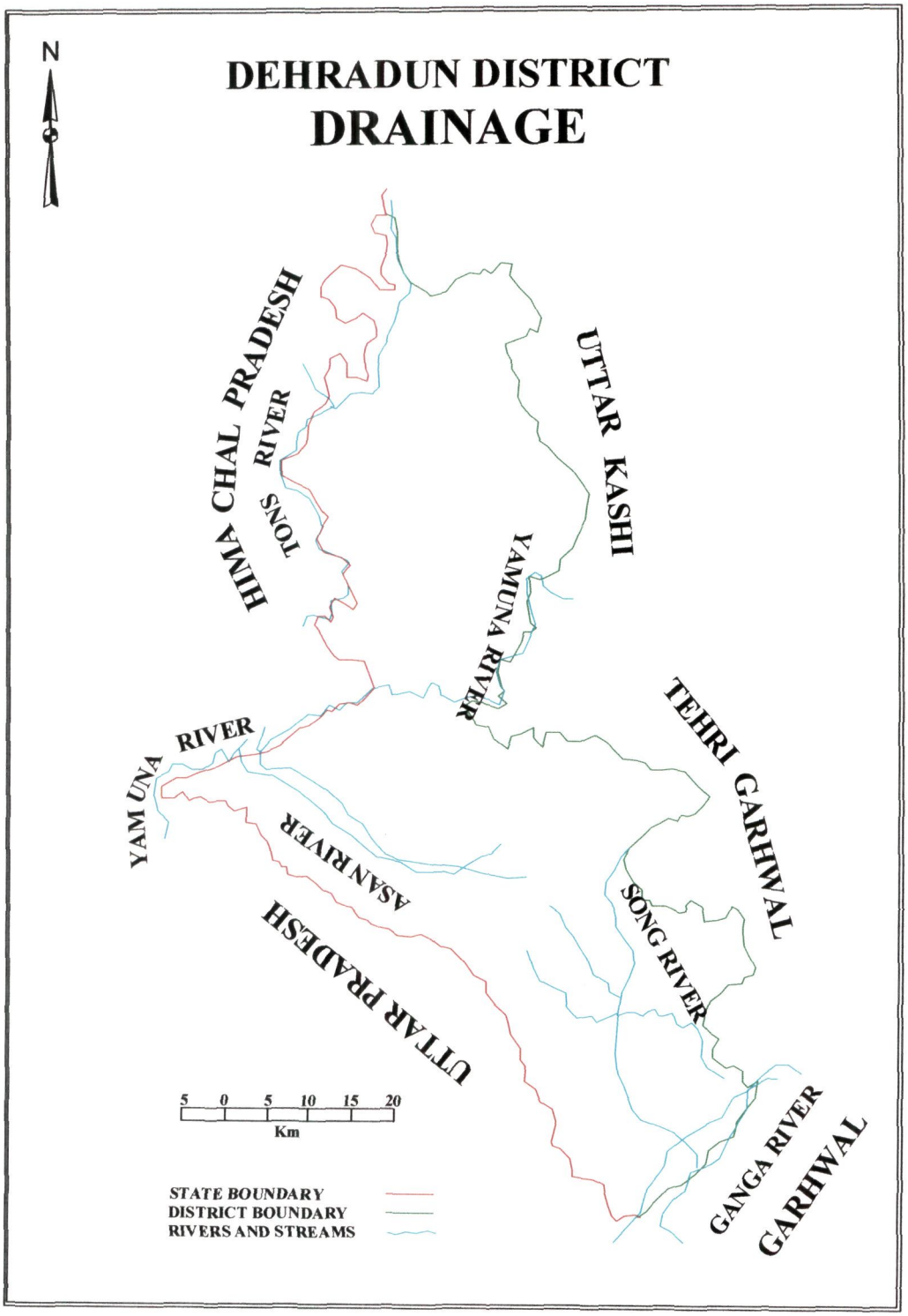
2.1(c) Drainage

The Dun is apparently a single valley but in reality it belongs to two great river systems, those of the Ganga and the Yamuna. Multitudes of torrents pour down from the Himalayan hills during the rainy season. They carry with them an immense volume of water, which continuously undermines their containing banks and thus the streambeds, widens until they cover a very large space.

The chief rivers of the district are:

1. **Ganga:** The Ganga touches the district at Rishikesh near which it receives Chandrabhaga nadi. It leaves the district near Hardwar after forming the boundary between Dun and Garhwal.

2. **Asan:** The Asan river rises in a clayey dip to the west of the Asarori-Dehra road, where it flows in a north west direction and finally plunges into the Yamuna. Tons is one of its chief tributaries which rises from the hill below Mussoorie.



Source : Regional Office, Census of India, Dehradun District, Uttaranchal

Fig. 2.1(ii)

3. **Suswa:** This river rises in a clayey depression near the source of the Asan to the east of the Asarori Dehra road. Then it flows a south east path and drains eastern Dun and receives during its course minor streams both from north and south. Suswa receives first the waters of Rispana Rao and then finally Song.

4. **Song:** This river, which originates in Tehri Garhwhal, runs parallel to Dun in a northwest direction and then finally unite with Bindal. During its course it receives Baldi river, then Suswa and lastly Jakhan Rao. The portions of the eastern Dun north of these rivers present a network of streams and it is often difficult to distinguish the main rivers from their tributaries.

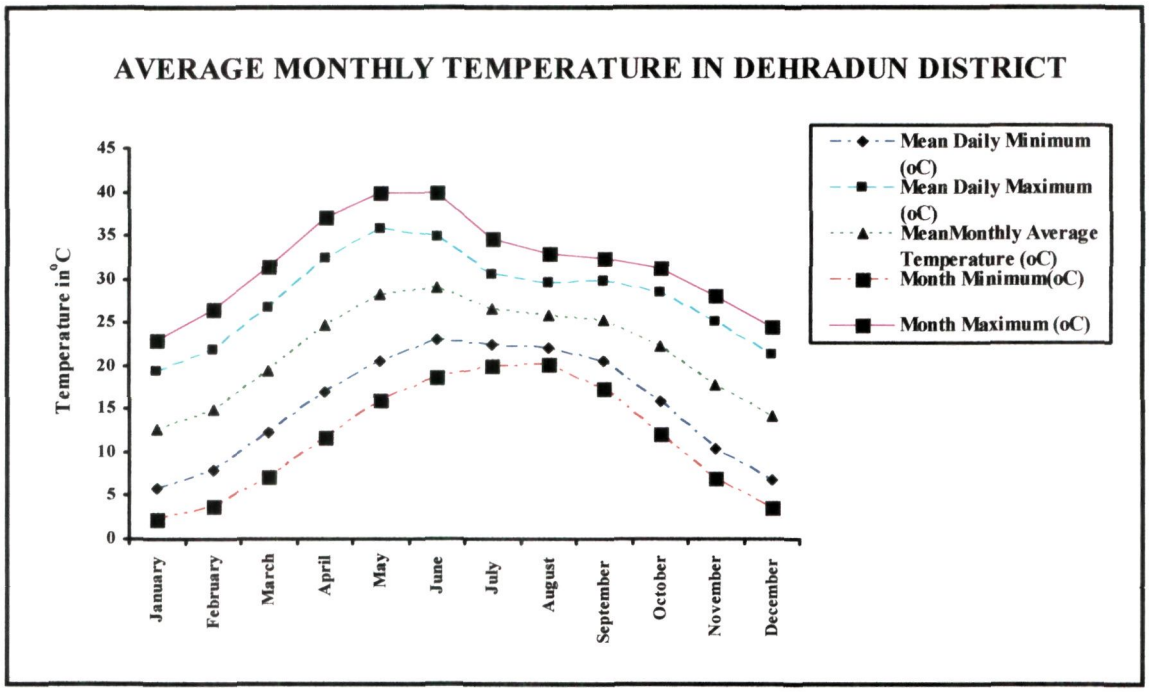
5. **Yamuna:** The Yamuna rises from Yamnotri. It enters the district about 20 km. due east of Deoband where it receives a small stream called the Riknar Gad.

6. **Tons:** This is the chief affluent of the yamuna in the district. It rises north of the yamnotri peak in the Harki Dun. First it meets Supin and later Rupin and from this point the united stream is called the Tons.

2.1(d) Climate

The climate of Dehradun is a moist and temperate one. The annual average rainfall is 2073.3 mm. The year can be divided into four seasons. The period from about the middle of November to February is the cold season. The hot season, which follows, continues up to about the end of June. The monsoon season is from July to about the third weak of September. The following period, till the middle of November, is the post monsoon season.

The valley, on the whole, is peculiarly free from sudden extremes of heat and cold, especially from the heat blasts, which scorch the country lying below its southern boundary, but due to extensive deforestation and extension of cultivation in the western portion of the Dun hot winds now accompany the advent of the summer months. These are not scorching in their effects but they


AVERAGE MONTHLY TEMPERATURE IN DEHRADUN DISTRICT
Temperature in °C
45
40
35
30
25
20
15
10
5
0
January
February
March
April
May
June
July
August
September
October
November
December
Mean Daily Minimum (oC)
Mean Daily Maximum (oC)
MeanMonthly Average Temperature (oC)
Month Minimum(oC)
Month Maximum (oC)

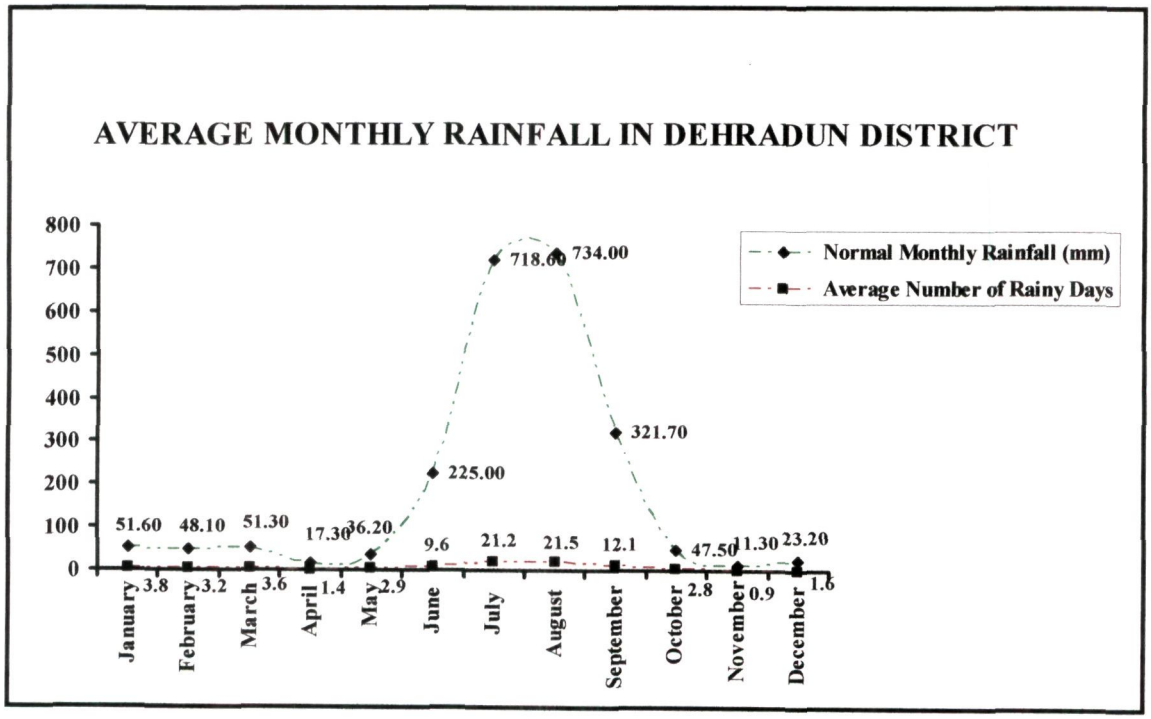

AVERAGE MONTHLY RAINFALL IN DEHRADUN DISTRICT
800
700
600
500
400
300
200
100
0
Normal Monthly Rainfall (mm)
Average Number of Rainy Days
51.60
48.10
51.30
17.30
36.20
225.00
718.60
734.00
321.70
47.50
11.30
23.20
3.8
3.2
3.6
1.4
2.9
9.6
21.2
21.5
12.1
2.8
0.9
1.6
January
February
March
April
May
June
July
August
September
October
November
December

Fig. 2.1(iii)

gradually become more marked and prolonged and are doubtless the consequences of rapid clearances of forests. These warm winds were unknown in the region before. From its close proximity to the outer Himalayan range, the region is also generally cool, the cold weather commences earlier and lasting longer than in the plains. There are no special prevailing winds; a mild breeze during the warmer months renders the climate at this sultry season tolerable.

The relative humidity is high during the southwest monsoon season, generally exceeding 70 per cent on the average. The mornings are comparatively more humid than the afternoon. The driest part of the year is the summer season with the relative humidity in the afternoon becoming less than 45 per cent.

TABLE 2.1(i)

AVERAGE MONTHLY TEMPERATURE IN DEHRADUN DISTRICT

Months	Mean Daily Minimum (°C)	Mean Daily Maximum (°C)	Mean Monthly Average Temp.(°C)	Month Minimum (°C)	Month Maximum (°C)
January	5.80	19.40	12.60	2.30	23.00
February	7.90	21.90	14.90	3.70	26.60
March	12.20	26.70	19.45	7.20	31.50
April	16.90	32.30	24.60	11.60	37.00
May	20.50	35.80	28.15	16.00	39.90
June	23.00	34.90	28.95	18.70	40.00
July	22.50	30.50	26.50	20.00	34.60
August	22.00	29.50	25.75	20.10	32.90
September	20.60	29.70	25.15	17.30	32.40
October	15.90	28.50	22.20	12.10	31.20
November	10.40	25.10	17.75	7.00	28.00
December	6.80	21.30	14.05	3.60	24.50

Source : Indian Meteorological Department, Lodhi Road New Delhi.

In the Dun, winds in the post monsoon and in the mornings in the rest of the year, are variable in direction, though northerly to north easterly winds and sometimes experience during post-monsoon and winter mornings.

During the cold season, passing western disturbances affect the weather over the district, causing occasional thunder storms which also occur during the summer and monsoon season. Fog occurs occasionally during the cold season.

TABLE 2.1(ii)

AVERAGE MONTHLY RAINFALL IN DEHRADUN DISTRICT

Month	Normal Monthly Rainfall (mm)	Average Number of Rainy days
January	51.60	3.80
February	48.10	3.20
March	51.30	3.60
April	17.30	1.40
May	36.20	2.90
June	225.00	9.60
July	718.60	21.20
August	734.00	21.50
September	321.70	12.10
October	47.50	2.80
November	11.30	0.90
December	23.20	1.60

Source : Indian Meteorological Department, , Lodhi Road New Delhi.

2.1(e) Soils

The classification of soils differ in two separate *tehsils* of Dehradun district, namely Chakrata and Dehradun.

In Dehradun, soils can be classified into Kachiana (Kachiana plus and Kachiana), Goind (I and II), Dakar Raunshili and sankra and in Chakrata Kyari, Ukari and Khil types of soil are found.

Kachiana plus is confined to the town and precincts of Dehradun and is utilized for garden cultivation and is adequately irrigated. Kachiana is the soil in all plots whether large or small where irrigation is secure and utilized to the full. Kachiana plus and Kachiana are, however, not important soil classes, such they account for only 2.1 per cent of the total cultivated area.

The Goind I and II, the rich and heavily manured soil, is found in Dehradun tehsil, in small plots attached to each house. Dakar is good clay and in rich Dakar land unirrigated crops can stand even long breaks in the monsoon. The three sub types of Rausili (I, II and III) are also found in the Dehradun tehsil, and represent a good loam Sankara, an inferior loam or clay of little depth and mixed with stones. The area of irrigated Sankra is not large. Unirrigated rice is seldom a failure in the Dun unless it is grown on Sankra land.

In the Chakrata *tehsil* the soils found are Kyari (irrigated). Ukari (unirrigated) and Khil, which is considered to be a good soil. Irrigated land is mostly found in the valleys where rivers and streams flow. The other types of land are found in the hill areas where cultivation is carried on in terraced fields. Cultivation on unirrigated and unterraced steep hill slopes is called *khil*. The fields are seldom manured because the land regains its fertility from the ashes of burnt grass and shrub. These fields are left fallow to allow grass and other vegetation to grow again, to be burnt and utilized for manuring afterwards. *Khil* does not require any watch or attention and once the seeds are sown the cultivator has only to wait for harvest.

Ross with regard to the nature of the soil said, "The Dun is without doubt here and there very fertile and has some very fine land, especially in the eastern Dun, but it cannot called a good wheat country, there is something wanting either in the soil or the climate where there is irrigation there are few

crops, but the wheat is never equal to the plains. Where there is no irrigation, it is a perfect matter of chance what the yield is, or whether there will be any yield at all. The surface soil is as rule shallow, and below it there is grand subsoil, this dries off all the moisture from the thin upper layers very soon, and so spring crop dwindles down to nothing".

2.2 ECONOMIC SETTING

2.2(a) Natural Vegetation

According to W.G. Moore, natural vegetation is the vegetation of a region as it exists or has existed before being modified to a marked extent by man e.g. through agriculture.

The study of natural vegetation of Dehradun can be made by broadly dividing the area into two-main natural vegetation region.

1. Natural vegetation of western part of tehsil Dehradun
2. Natural vegetation of eastern part of tehsil Dehradun.

1. The Western part of Tehsil Dehradun

The vegetation can be broadly classified into two botanical divisions.

a. Sal Forest

They occur over the Dun Valley up to the top of the Siwalik ridges in the south, and upto an altitude of about 1,300 mts in the north, Sal here is generally pure, but towards the top of the Siwalik ridges, mixture of miscellaneous species increases and, at some place, Chir is found mixed with Sal. The main associates of Sal to name a few are *asna, haldu, bahera* etc. *rohini, chamror, bhilawa* and *maidalakari* etc. are found between the top of the Siwalik ridges and lower parts. Some of the common shrubs such as *Karu, gandela, binku or ban, bansa, besinga, bhang, bamboo, malijan, alga, alai, amarbel, kalidudhi* are the commonly found climbers of this region.

b. Coniferous Species

The only coniferous species, which is found in the old reserved forests of Dehradun, is Chir. Few deodar trees are also visible. The associates of Chir are *banj, oak, ayar, burans* and *mehal.* The undergrowth consists of *silmora, sakina* and *hisala* etc. Near the streams sheltered localities are found with heavy growth of shrubs *like kilmora, dhaula, thor, bhilmora, kuri* and *satawar.* The commonly found grasses of this regon are *goria* or *gorla, kumaria, nakli, bhabar* and *ringal.*

2. Eastern part of the Tehsil Dehradun

The flora here may be divided into fourteen botanic divisions.

a. Moist Siwalik Sal Forests : The Sal trees growing here are of very low quality.

b. Moist Bhabar Dun Sal Forests : The forest cover an area of 160 sq.km. Sal is the dominant species, and its associates are *sain* and *dhauri.* The other varieties found are *sande, dhaman, rohini, chamror, amaltas, jamun, Machilus, sarunda, chemeli* and *gaujand*

c. West Gangetic Moist Deciduous Forests : : They represent closed forests of medium to good height. The species are as *safed siris, behera, jhingan, kharpat* and *dhauri, karaunda, vasica* and *jharberi.*

d. Low Alluvial Savanna Woodland Forests : The tree growth is generally poor and scattered consisting of *ambara, semal, saijana, kharpat, dhauri* and *siris.*

e. Sub-Montane Hill Valley Forests : The species occurring are *gular, gutel, jamun, tun, safed siris* and occasionally *semal* and *khair.* The underwood consists of *kala a tendu,* the undergrowth comprising *cane* and *ardesia solanacea.*

f. Dry Siwalik Sal Forests : These forests occur on the higher slopes of Siwalik, here it is the predominant species in the overwood, its main associates being *sain, bakli, pipal, Kachnar* and *guiral.*

g. Northern dry Mixed Deciduous Forests : In the plains these forests consist of *semal, khair, kanju, bahera, amaltas* and *bel.* In the hills the common species found are *bakli, semal, jhingan, bahera, khair, rohini, genthi, khini, mandara,chamror, chilla* and *harsingar.*

h. Dry Deciduous Scrub Forests : These forests represent a degradation stage of the dry deciduous forest. The main species of trees found are *jhingan, khinni, mandana* and *amaltas.* Common shrubs are *harsingar karaunda, mainphal, gandhera* and *bindu.*

i. Khari Sissoo Forests : These forests occur on gravelly alluvium of streams and rivers, *Khair* and *sissoo* occur mixed but the latter generally predominates. The undergrowth consists of *basingha, gandhela* and *ber.*

j. Sub-tropical Siwalik Chir Forests : These forests are mixed with dry mixed deciduous forests and Sal forests. The pines stand singly or in-groups.

k. Sub-tropical Himalayan Chir Forests : These forests occur in local and in small patches.

l. Himalayan Sub-tropical Scrub Forest : The tree species mostly occur along moist ravines and mullans and consist of *fieus renburghil, burans ban* and *Pyrus pasnia.* The shrubs usually consist of *Indigofera, Rubus ellipticus, vibrum* and *Euphoribea species.*

m. Banj Forests : These forests occur almost performing a somewhat open canopy of sapling and poles of coppies growth in Thano forest range.

n. Himalayan Temperate Secondary Scrub Forests : They represent a degradation stage of banj forests. The common shrubs are *kilmora, Rubus ellipticus* and *surai.*

2.2 (b) Land Utilization

The district of Dehradun can be divided into three main agricultural divisions :

a. The Dehra plateau

b. The riverian land

c. The Sub-montane tract

The Dehra plateau is the best suited for cultivation out of the three, and best quality wheat is grown here. Next comes the riverian land where Dehradun's famous Basmati rice is grown. Lastly comes the submontane tract which is dry, stony and unprofitable, yielding rain crops only, which are good or bad, as the rains are abundant or scanty.

According to 2001 census the area under forest was 201831 hectares accounting for about 54.26 per cent from total reported area Table 2.2(i).

TABLE 2.2(i)

LAND USE PATTERN IN DEHRADUN DISTRICT (2001)

	Percentage to the Reported Area
Forest	54.26
Area under non agricultural land	6.17
Barren and uncultivable land	0.54
Permanent Pasture and other grazing land	0.07
Land under miscellaneous tree crops and groves not included in net area sown	4.34
Culturable waste land	16.88
Fallow lands other than current fallows	1.58
Current fallows	1.90
Net area sown	14.25

Source : Census of India 2001, Dehradun, District Statistical office.

2.2 (c) Agriculture

Agriculture is practiced in the Dun valley in the same fashion as in plains but here hard labour and skill is required. Canals and rivers provide abundant facilities for irrigation but this area lacks in manure. The hills have very little level ground and hence terraced cultivation is practiced. Cultivation

in the hill tract of Dehradun tehsil and throughout the Jaunsar, Bawar is generally regular and intermittent. Terraced fields form the backbone of hill cultivation. These fields are lavishly manured and when water is available and when rains are good production of crops is also good. Small patches of hillsides are cleared of shrubs and grasses and then they are cultivated for a year or so and then left fallow. This type of cultivation disintegrates the hillsides and causes slips and this in turn damage the terraced fields at the foothills.

In Dehradun crops are grown both in *Kharif* and *Rabi* seasons. The chief crops of *Kharif* are rice, *mandua, jhangora* and *sonk* together with, pulse specially *urd* and *kulath*. Another important crop is *tor* (arhar); *Cholai*, a Kharif crop, is peculiar to the hills.

The Rabi crops grown here are barley, wheat and mustard. Sugarcane is also grown.

Among the fruit grown here are mango, guava, peach, grape, strawberry, pear and lemon.

All kind of vegetables are grown in the district, potato being the most important crop. The common vegetables grown here are brinjal or egg plant, raddish, lady's finger, carrot and various beans, pumpkins, gourds, melons.

2.2(d) Industry

The district has 97 registered factories engaging 8,751 persons. The value of the product is 455.39 million rupees annually. There are two heavy industries in the district. The Indian Drugs and Pharmaceuticals Ltd, A Government of India undertaking was established with Soviet Collaboration at Virbhadra for manufacturing antibiotics. The Sturdiac chemicals Ltd., which produces calcium carbonate,another heavy industry in the private sector was established in 1963. Woolen and synthetic tops, woolen cloth, sugar, cotton yarn, wheat products, medicines and miniature bulbs are manufactured in seven large-scale units. They are Sri Janki Sugar Mills Co. Ltd. Amitash Textile Mills Ltd. Miniature Bulb Industries of India Ltd. Bengal Immunity Ltd., Doon

Valley combers (P) Ltd., India woolen Textile Mills (P) Ltd. and Raj Narain Floor Mills Ltd.

A variety of items are produced in small scale units of industries like dairy, canning and preservation, bakery, chocolate, khandsari, tea, malt, textiles, cardboard boxes, printing, timber goods, steel furniture, liquor, ayurvedic medicines, rosin and turpentine, tubes, leather products, musical instruments, optical lenses, miniature bulbs, medical instruments, automobile industries, agricultural implements, utensils and hospital equipments, weigh bridges, sewing machines, metal goods and plaster of paris etc.

In the rural area of the district a number of cottage and village industries like wool industry, handloom cloth, power loom, dairies, tailoring, oil, gur, rice, apiary, baskets, cots and mats, walking sticks, pottery brick kilns, Smithy, leader flourish etc.

Under the Sericulture scheme the Government control silk farm was established at Prem Nagar in the district. The farm distributes healthy mulberry trees to the silk warm rearers in the district and a good amount is earned from the production of cocoons.

2.3 SOCIAL PROFILE

Dehradun, supporting a population of about 1282143 persons with an average density of 415 persons per sq.km. is one of the densely populated districts of Uttranchal. The highest density of 585 persons and lowest of 289 persons per km is found in blocks Doiwala and Sahaspur respectively. Out of the total population, 53 percent were male, while 47 per cent were female. Rural population accounts 47.06 per cent of the total population (2001 census). The district with an average literacy index of 68.35 per cent ranks 2nd highest in the state the literacy percentage among the male is 57.66 per cent while it is 42.33 per cent in case of females. The percentage of literate persons also varies from block to block. Block Raipur ranks first in this field, while block Chakrata

occupies the lowest place. The district is inhabited by the people of various castes and creed Table 2.3(ii).

2.3 (a) Population

The population of Dehradun was 1282143 (2001 Census). Table 2.3(i) reproduces data from population census taken at regular interval from 1901.

TABLE 2.3(i)

POPULATION GROWTH IN DEHRADUN DISTRICT

Year	Total Population	Variations	%of Variations
1901	177465	-	-
1911	204534	+27069	+15.25
1921	211877	+7343	+3.59
1931	229850	+17973	+8.48
1941	265786	+35936	+15.63
1951	361689	+95903	+36.08
1961	429014	+67325	+18.61
1971	577306	+148292	+34.57
1981	761668	+184362	+31.93
1991	1025679	+264011	+34.70
2001	1282143	+256464	+25.00

Source : Census of India 2001, Dehradun District Statistical Office.

2.3(b) Principal Communities

Of the total population of the district 84.71 per cent are Hindus (2001 census). Second in hierarchy are Muslims who constitute 139197 persons and are 10.85 per cent of the total population of the district. The percentages of other communities are 0.39 (Jains), 0.58 (Buddist) and 0.80 (Christians) in the year 2001.

TABLE 2.3(ii)

RELIGIOUS COMPOSITION OF THE POPULATION IN DEHRADUN DISTRICT 2001

Religion	Total Population	Percentage of total population	Percentage decadal growth 1981-91
Hindu	1086094	84.71	24.16
Muslim	139197	10.85	40.96
Christian	10322	0.80	15.35
Sikh	33379	2.60	9.74
Buddhist	7499	0.58	-10.14
Jain	5018	0.39	20.65
Others	166	0.01	-26.22
Religion not stated	468	0.03	515.79
Total	1282143	100.00	

Source : Census of India 2001, Dehradun District Statistical Office.

2.3(c)Occupational Structure

TABLE 2.3(iii)

OCCUPATIONAL STRUCTURE IN DEHRADUN DISTRICT (2001)

Occupation	District			Rural			Urban		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Cultivator	61619 (18.31)	42031 (12.49)	19598 (5.82)	60329 (17.93)	41000 (12.18)	19329 (5.74)	1290 (0.38)	1021 (0.30)	269 (0.08)
Agricultural Labourers	11775 (3.50)	9863 (2.93)	1912 (0.57)	10945 (3.25)	9200 (2.73)	1745 (0.52)	830 (0.25)	663 (0.20)	167 (0.05)
House hold Industry	7496 (2.23)	6808 (1.72)	1688 (0.50)	3847 (1.14)	2817 (0.84)	1030 (0.31)	3649 (1.08)	2991 (0.89)	658 (0.19)
Other workers	2555614 (75.96)	226584 (67.33)	29030 (8.63)	78793 (23.41)	70037 (20.81)	8756 (2.60)	176821 (52.54)	156547 (46.52)	20274 (6.02)
Total Main workers	336504 (100.0)	284276 (84.47)	52228 (15.52)	153914 (45.74)	123054 (36.57)	30860 (9.17)	182590 (54.26)	161222 (47.91)	21368 (6.35)

Source : Census of India 2001, Dehradun, District Statistical Office.

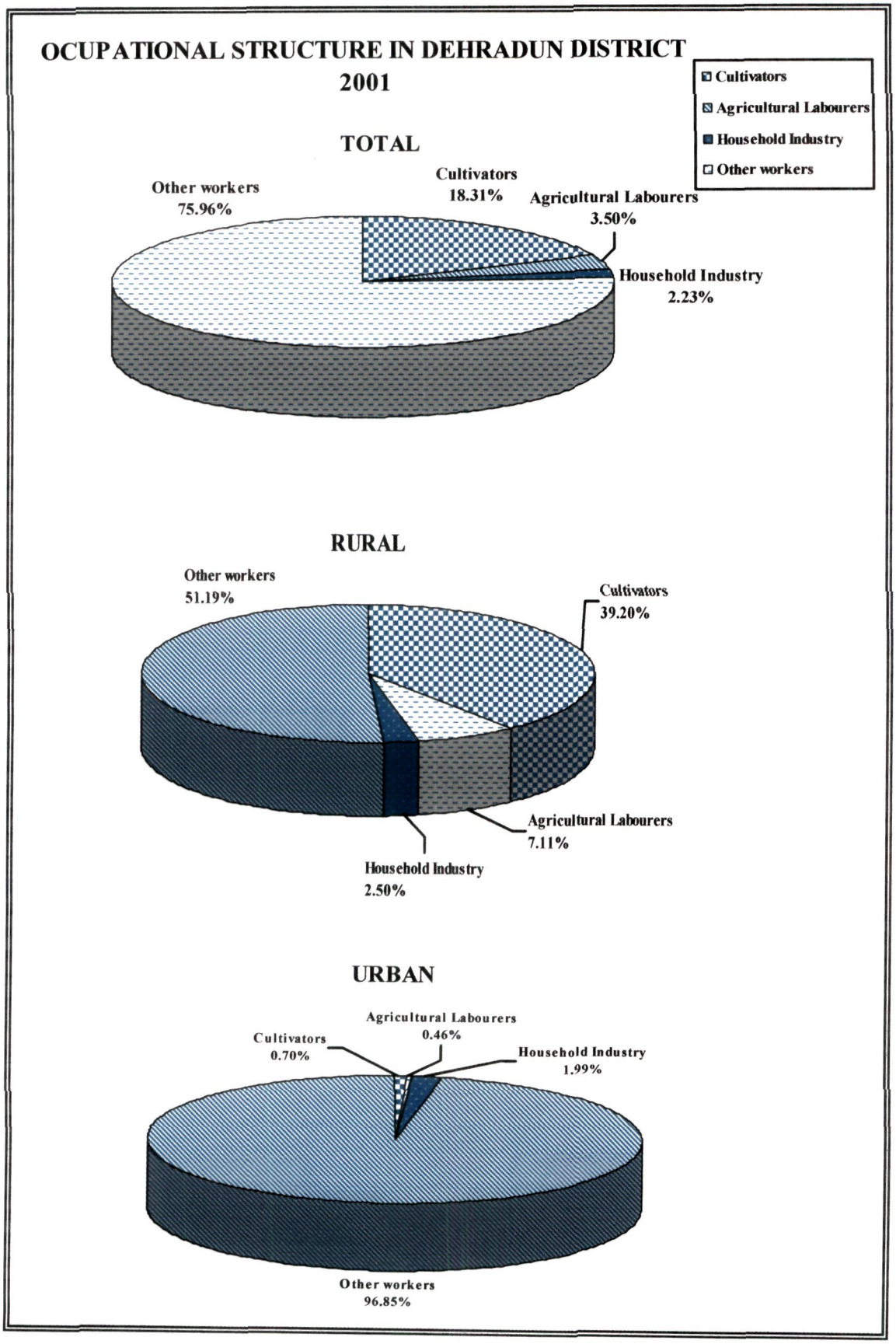

OCUPATIONAL STRUCTURE IN DEHRADUN DISTRICT
2001
Cultivators
Agricultural Labourers
Household Industry
Other workers
TOTAL
Other workers
75.96%
Cultivators
18.31%
Agricultural Labourers
3.50%
Household Industry
2.23%
RURAL
Other workers
51.19%
Cultivators
39.20%
Agricultural Labourers
7.11%
Household Industry
2.50%
URBAN
Agricultural Labourers
0.46%
Cultivators
0.70%
Household Industry
1.99%
Other workers
96.85%

Fig. 2.3(i)

The working population has been divided into four major categories, viz cultivators, agricultural labourers, household industry, and other workers. Cultivators occupy about 18.31 per cent of the working population but uniformity is not observed in their distribution (Table 2.3(iii)). There is a lot of variation at the Block level.

Agricultural labourers constitute about 3.5 per cent of the total working population. The population engaged in household and other manufacturing activities make 2.23 per cent of the working population. The person engaged in other services include the person working in services, transport, trade and commerce and in any other economic activity than the above three categories forming about 75.96 per cent of the working population.

Chapter 3

Ecological Basis of Environmental Management

Chapter - 3

ECOLOGICAL BASIS OF ENVIRONENTAL MANAGEMENT

It has been known from the *vedic* times that nature and human kind form an inseparable part of the life support system. This system has five elements, air, water, land, flora and fauna, which are interconnected interrelated and interdependent and have co-evolved and are co-adopted. Deterioration in one inevitably affects the other four elements (Khoshoo, 1988).

Basically, it is the need of the poor, the greed of the rich and the careless application of technology that have been the main cause of environmental degradation in the world. We are now at the cross-roads. Our numbers are growing rapidly everyday and to feed, cloth and shelter the mounting population, we have to draw on nature's not so limitless bank. The dangers are clearly apparent already and the principle is looming large before us. Unless concerted and united efforts are made now, tomorrow may be too late.

All is not yet lost, despite the dents and damages to the mother earth that has already been inflicted. With careful environmental management, much can be repaired and a lot can be avoided in the future. The striking feature of the decade is that we have begun to unravel and understand the complexity of ecosystems that our attitude to environmental conservation has changed from "Touch me-not" to "use me-wisely".

In India, we face the dual problem of population growth and poverty. To these we can trace almost all our major environmental problems like the denudation of forests, overgrazing, sewage pollution, malnutrition, communicable diseases, etc simultaneously in part of the country. The environmental problems due to industrial pollution and urban

congestion can be clearly disconcerned still, one must recognize that the situation has not been reached the point of no return and by restoring to appropriate environmental management, by integrating the inseparable economic and environmental systems, and by creating environmental awareness among the mass of people, we can choose ecologically compatible paths of development.

It may be emphasized here that just anyone cannot be a component environment manager; likewise, effective environmental management has to be used on a scientific and technological approach which takes full note of the socio-economic parameters and compulsions.

Recent experiences from all over the world clearly indicate that environmental management as a means of social change has to be fully backed by the political system concerned. In this respect, we are fortunate in India because of the deep commitment of our government to nature conservation and environmental protection (Khoshoo, 1988).

Some of the Major Tasks before us are

(a) Population control and health care;

(b) Integral land use planning and water shed management; re-vegetation of marginal lands for halting deforestation and desertification for purpose of firewood, fodder and long term environmental security. In essence, it involves greening the *uncultivated half of India;*

(c) Water pollution control in river systems;

(d) Air pollution control in industrial pockets;

(e) Development of reliable non-polluting renewable energy;

(f) Solid waste utilitazation through recycling;

(g) Conservation of biological diversity in its totally;

(h) Development of new types of human settlements without congestion and above all, affecting slum improvement; and

(i) Environmental education and awareness at all levels of society.

There is a growing feeling among nations that the environmental problems can best be solved through regional and sub-regional co-operative efforts, as these problems recognize geographic but not political boundaries. This feeling is reflected in the establishment of several regional programmes.

Our technical skill in unraveling environmental issues is also not wanting. One is indeed hopeful that the outlook for the next decade is bright for environmental action, and if we all join together in this movement, the goal of environmentally acceptable development will not elude us on account of their being primary producers, plants have a key role in maintaining our life support system. Having realized that the future of human kind is bleak on a plantless earth, never before has there been such a resurgence of interest in plants and plant cover as at present. Therefore, the least we can do is to make India greener and greener. This will generate a healthy environment which in turn will lead to healthy economy for the present as well as the future generation (Khoshoo, 1988).

As concern for environmental protection and conservation of environment have increased world-wide, the detrimental impacts of pollution and human dominance on natural ecosystems have become increasingly important for resource management. There is no doubt about the progress and prosperity brought about by industrialization, however, the materialistic progress has ruthlessly demolished the very natural surroundings and is posing threat to environment. Deforestation has led to destruction of wild life, soil erosion, and loss of soil fertility, floods and formation of deserts. Urbanization and unplanned expansion of cities have created the problem of waste disposal, sanitation and provision of pure water and clean air.

The environmental problems of developing countries are not just the side effects of excessive industrialization and also due to man's incomplete knowledge of the possible impact of scientific development. Progress has become synonymous with an assault on nature. Industrialized countries witnessed much more acute environmental pollution and began realizing its adverse impact of the lives of the people which were sought to be enriched through industrial production. The United Nations Conference on Human Environment held at Stockholm in June, 1972 proved very timely with it began an era of increasing consciousness world wise regarding the urgent need for protection of the environment.

It was fortunate that our country took up this matter in right earnest. To make people aware of environmental protection constitution was amended. Article 48(A) and 51(A) were added to the constitution there by imposing duties on Government as well as citizens for protection and improvement of the environment (Maruthi and Rao, 1999).

PERPECTIVE IN ENVIRONMENTAL MANAGEMENT

An ever-increasing population with aspiration for a quality of life hitherto unknown is placing a tremendous stress on all that the environment can provide; so much so, in parts, the environment has started to give way. Evidence of these phenomena can be seen in the spread of desertification, soil maladies, floods and droughts, urban congestion extinction of/or threat to countless species of plants and animals that make the ecosystems and the ubiquitous pollution of land, water and air. And yet, the population growth has not been arrested, the demands for food, shelter and clothing, energy and other basic needs of society have not abated nor has the realization, that environmental resources, even renewable ones, are finite, grown.

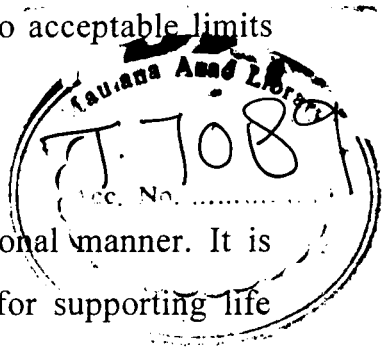
Therefore, environmental management is proper resource use and resource management. Environmental management is an interdisciplinary

approach to resource conservation and recycling and it acts as regulatory force on human wantonness in resource exploitation and resource wasting. The central theme of environmental management is thus the reduction or minimization of the impact of human activities on the physical and ecological environment. It is an endeavour to avoid the over use, misuse and abuse of the resources in the environment.

At the global level, the UN has established the United Nations Environmental Programme (UNEP) which has been given a catalytic role to urge appropriate actions to halt and reverse environmental degradation in various parts of the world. Several countries have also initiated programmes for environmental improvement and set up organizational structures for dealing with the environmental problems in their own countries. The world conservation strategy launched world over is based on the theme of development without destruction and the concept of protecting ecosystems for providing the base for sustained development. The Indian government, which has been sensitive to environmental concerns from the beginning, has set up a Department of Environment at the center with over all responsibilities of ensuring Department protection and conservation (Khoshoo, 1988).

Concern in Developing Countries: Environment is the resource comprising land and all that it contains on the surface and beneath, water and the life it supports and air, Government then, is concerned with wise management of resources, which is synonymous with environmental management. Government, even now, carries out this function of environmental management when it manages agricultural land and practices for sustained yield of food products, when it manages energy resources for energy production and distribution and while depending the nation against aggression, it infact manages the security and sovereignty of land and water holdings and airspace. Government is thus the supreme manager of the environment. This is what environmental management to

do. Conserve what needs to be conserved, protect what needs to be protected and regulate utilization of natural resources to acceptable limits (Khoshoo, 1988).



ENVIRONMENTAL MANAGEMENT STRATEGY

In order to manage the environment in a rational manner. It is necessary to access the potential of the environment for supporting life processes and for providing the resources for development. This is vital for the continued progress of mankind. Population regulation is a concomitant necessity for environmental management. A very similar problem is that of management of a city. As it grows beyond a certain optimum size, the cost of providing essential city services become prohibitively expensive with consequent deterioration of the quality of life. The earth may then be maintained at an optimum level such that the quality of life for all does not fall below desirable standards. Although cities are the engines of economic development, failure to manage the impacts of rapid urbanization is threatening human health, environmental quality and urban productivity. The immediate and most critical environmental problems facing are lack of safe water, inadequate waste management and pollution control, accidents linked to congestion and crowding, occupation and degradation of sensitive lands, and the interrelationships between these problems. Their cost falls most heavily on current generations, particularly the urban poor, who are most affected by poor health, lower productivity, reduced incomes, and lowered quality of life.

The challenge of rapid urbanization will be to sustain economic growth while solving the associated environmental and social equity problems. Tackling the environmental problems, therefore, presents a unique opportunity to improve health and living conditions as well as increasing macro economic performance in the rapidly growing cities.

It is quality of life that people aspire to which may set the environmental goals. The end objective of environmental management is to achieve these environmental goals. The environment, we speak of here is a few cmts of soil on which terrestrial life is dependent, a few meters of water in which aquatic life can thrive, and a few kmts of air without which nothing can survive to prevent such a doom, environmental management practices must be adopted now. Conservation therefore is an environmental management goal. It implies the wise use of resources in the environment for sustained development.

The following are the important aspects (the world conservation strategy is based on these premises):

(a) Maintenance of essential ecological processes and life systems;

(b) Preservation of genetic diversity; and

(c) Sustainable utilization of species and ecosystems;

There is a measure of urgency in this for;

(a) The capacity of the environment to support the growing population and its increasing consumption is being irreversibly reduced;

(b) Impoverished rural population in developing countries are compelled to use up and destroy the very resources they need to free them from starvation and poverty;

(c) The reduced stability of natural systems has led to the rise in cost of goods and services; and

(d) The resources base of major industries is shrinking.

The world needs secure sources of food and energy. For such security, the important steps to be taken are;

(a) Maintenance of genetic diversity;

(b) Combating soil degradation;

(c) Controlling deforestation and overgrazing;

(d) Arresting the spread of deserts;

(e) Curbing exploitation of terrestrial and aquatic resources; and

(f) Abating environmental pollution.

Sound environmental management is the optimal allocation of finite resources between different possible uses. Environmental criteria and economic considerations favour that such allocation should be efficient. Simultaneously, the available resources should be protected from degradation and scares and diminishing resources should be conserved.

When there is talk of environmental management activities like mining, finishing, grazing and manufacturing, or environmental systems such as water bodies, atmosphere and forests, what is implied is that in the former case, direction must be exercised to avoid over-exploitation of resources and in the latter, conservation should be practiced to preserve their sanctity (Khoshoo,1988).

ENVIRONMENTAL MANAGEMENT

The cornerstones of environmental management are

(a) Environmental Planning

(b) Environmental status evaluations

(c) Environmental impact assessment

(d) Environmental legislation and administration

(a) Environmental Planning: The environmental planning concept is rooted in the integration of environmental considerations in the economic development planning process as hitherto practiced.

The environmental planning process has to set the policies, priorities and techniques in such a manner that it can be readily reviewed and modified on a systems feedback basis. It has therefore to be:

a) Flexible in approach;

b) Sensitive to exploitation of natural resources, impacts on employment, prices and quality of life in human settlements;

c) Capable of identifying and developing alternative development avenues;

d) Receptive to public participation at different levels of decision making;

e) Catalytic to the development of regional and local potential;

f) Creative and modalities at regional and local levels; and

g) A conscious policy framework for attaining a dynamic balance between environmental, social, political and economic concerns.

Environmental planning cannot succeed without taken the following actions:

a) Acceptance of improved quality of life as a basic element of social policy;

b) Adoption of anticipatory steps for integration of environmental view on economic and social decision making;

c) Encouragement of public participation in solving conflicts and trade between different development options;

d) Collaboration of government machinery, industrial structures and academic expertise in evolving a new way of thinking about systematic relationship between economy, energy and environment, and

e) Making environmental protection and conservation compatible with socio-economic goals of a society already burdened with problems of energy crisis, rising unemployment and spiraling prices.

Environmental planning attempts to facilitate economic development, while avoiding, as far as possible or minimizing certainly, concomitant environmental damage.

Environmental management needs an integrated planning approach, which is aimed at managing human activities in order to maintain an acceptable balance between the qualities of the human and natural environment. This is obviously dependent on the value judgement of the society, which is anything but consistent and may vary widely with circumstances and with time.

(b) Environmental Status Evaluation: For management of a system a system status is a must. In the case of complex dynamic system like the environment, this task is not only extremely difficult, but also fraught with several uncertainties. There is no single parameter or index of the status in such cases. Also the derivation of an index y suitable computational technique of using several critical parameters is not only imprecise but also far too complex for current techniques to handle.

Under these circumstances, one possible approach would be to attempt evaluation of status of sub-systems. The conceivable sub-systems of the environment though not exhaustible, are

Sub system	Index of status
Air	Air Quality
Water	Water quality
Land	Soil characteristics/Productivity
Flora and Fauna	Population size, population Dynamics, Genetic Diversity

A comparison of environmental status between two points in time or space may be attempted, using one or a few parameters for a specific environmental component. In future, a more extensive and thorough

research effort to apply systems analysis techniques for assessing environmental quality has to be urgently undertaken.

(c) Environmental Impact Assessment (EIA): Environmental impact assessment (EIA) is one of the primary tools to date for the environmental manager and a useful guide for decision making. It is a procedure for bringing out the potential effects of human activities on environmental systems. In some cases, such as pollution impacts, a certain measure of quantification is possible, but in respect of long term ecological and social impacts, the desired degree of quantification is not achievable currently. The most significant output of the EIA is the inter comparison of development options and the screening of alternate sites for locating development projects. The EIA identify measure and evaluate both the beneficial and adverse environmental impacts of the development projects.

The methodologies lay emphasis on enumeration of possible impacts, data collection and display rather than of their relative importance, since the latter, namely the appreciation of the relative weight of the values, is really the prime purpose of the assessment, it cannot be said that EIA procedures as practiced today are the last world in environmental assessment.

Criticism about EIA include

(a) It is time consuming and expensive;

(b) It is not very efficient or convincing approach for integrating environmental aspects in development appraisal; and

(c) It is useful only for massive and unique projects and not worthwhile in the case of the medium size routine development projects.

(d) Environmental Legislation: Environmental legislation supported by well drafted regulations and meticulous enforcement systems and administrative machinery is an essential component of environmental

management. The legislative scope covers a wide range, including land use, water rights, pollution control and abatement, forest protection, wild life conservation, town planning, industrial licensing regulations concerning toxic chemical manufactures formulation, sale, use and disposal, food contamination and adulteration, mining leases, patenting plants and organisms and so on.

Legislation by itself is not sufficient for enforcing and implementing environmental action. Persuasion and education are also equally important. Incentive and disincentive packages are also considered as persuasive methods to achieve compliance with environmental goals.

REQUIRED SUPPORT FOR ENVIRONMENTAL MANAGEMENT

In order to undertake environmental management practice, the following support systems are necessary:

a) Environmental Management Information System

b) Environmental Monitoring and Surveillance System

c) Environmental Research

(a) Environmental Management Information System: We need to know the status of the environment, before we can attempt to manage it. An adequate environmental information system is an indispensable adjunet to the environmental management system. Irrespective of the data accumulation process, the environmental information system must have built in sub-systems for data analysis and interpretation and for wide dissemination of relevant information, data and result of analysis to users, who ever they may be.

(b) Environmental Monitoring and Surveillance System: Environmental monitoring systems are equally important for successful environmental management.

Three sub-systems for monitoring environmental change are:

Firstly, a network of voluntary observers of environmental quality is necessary for alerting the concerned agencies about gross disturbance occurring in any locality.

Secondly, we need sophisticated networks for observing specific environmental quality parameters in a systematic and continuous manner.

Thirdly, is the impact monitoring sub system. This involves the periodical evaluation of the status of the environment and its components and includes the health status of the people, population dynamics of human being and sensitive species, the yield of plants and animals, the productivity of soil and so on.

(c) Environmental Research: Research, both basic and applied is, of course, the prime pre-requirement for initiating environmental management programmes.

Research is also needed into the methodology of environmental appraisal, improved techniques for monitoring environmental appraisal, finding solutions for imminent environmental problems, controlling environmental degradation and, last, but not the least, reversing environmental trends and restoring the health of the environment (Khoshoo, 1988).

Chapter 4

Natural Environment

Chapter – 4

NATURAL ENVIRONMENT

Environment is the source of life on earth and it not only directs but also determines the existence, growth and development of mankind and all its activities.

As society developed, man's impact on environment grew in scope and strength. Until very recently, we adhered to the following dictum: "we cannot expect favours from nature, we must take them". Mankind has long trusted in nature's potential and restorative powers, though there was no reason to believe that these powers were inexhaustible, undoubtedly, this is the result of revolution in science and technology, which has dramatically increased man's ability to use natural environment and its resources. Nature has been increasingly damaged, restorative capabilities have progressively weakened, and human environment is deteriorating day by day to point of affecting not only the quality of life but even the very existence of life. At this point, man realized the need to preserve and improve his environment, which is now called as the ecological approach (Saxena, 2006).

The word resource means "a source of supply or support generally held in reserve". A natural resource is the stock that can be drawn from nature, i.e. air, water, land, vegetation, animals, solar energy and raw materials, for supporting life. For man, resources are those materials which are needed for survival and prosperity. The nature of resources varies from society to society, depending upon culture, level of development and the nature of work of that particular society.

A 'reserve' on the other hand is that portion of a resource which is identified and from which usable materials can be legally and economically extracted at the time of evaluation.

Natural resources can be classified as (i) renewable resources and (ii) non-renewable resources, on the basis of their abundances and availability. Resources that have the inherent capacity to reappear, or replenish themselves by quick recycling, reproduction and replacement within a reasonable time and maintain themselves, are called renewable resources, e.g. soil, water and living organisms. Resource that lacks the ability for recycling and replacement are called non-renewable resources, e.g. fossil fuels like coal, petroleum and minerals. Renewable resources can become non-renewable if used too rapidly by improper management (Rana, 2003).

4.1 FORESTS

Forests which are often considered to be the most splendid manifestation of plant life on earth, have played so important a role in the development of civilized man, providing him with materials for building his homes, for his furniture, fuel requirements, food material like berries and roots and so many other things, that it would have been difficult for man to make the rapid progress he has if they had been absent. In modern times forests have been increasingly, used as raw materials for paper and pulp and other industries. However, they have been the subject of such large scale exploitation that their very future is gravely imperiled. Perhaps because of a feeling that there were vast reserves of forests, exploitation has taken place on a reckless scale. While the commercial uses of timber have been recognized, their ecological value unfortunately has been largely overlooked. It is now increasingly appreciated that forests help to minimize soil erosion, have an important role in moderating climate and provide the habitants for large number of animal species. At the same time within the forest canopy many kinds of shrubs and other plants are to be found, many of them providing very useful substances like gums, resins, dyes and chemical substances of medicinal and industrial value. The tropical rain forests are particularly rich in plant and animal species and they are, sadly,

the ones in greatest danger. According to the National Forests Policy formulated in 1952, about 33 percent of the total land area should be maintained under forest cover but large scale deforestation has brought down the actually forested area to a considerably lower figure. (Pal, 1982)

Review of Literature

Any systematic survey of changes in structure and composition of forest of the area is not available. It has been mentioned that "great transformation has taken place in the Himalayan flora due to ravages caused by the tremendous biotic pressure, over exploitation of commercial tree species, the lopping felling of Oak species for fuel, fodder, timber, furniture and agricultural implements (Planning commission, 1985). It has also been mentioned that erosion, land-slides, floods and avalanches bring about changes in topography with consequent effects on the vegetation (Rau, 1981). It was in 1923, when Champion referred to the effect of fires, felling, grazing and removal of leaves in forest zone with particular references to the contact between the low level Chir Pine and the White Oak (Champion, 1923). It was stated that Chir Pine grows taller but is ordinarily prevented from regeneration by the thick under growth of Oak. The lopping and felling of Oak results in the soil becoming drier and thus, non favourable to Pine (Rau, 1981). Pine being a commercial species is subjected to heavy destruction and has led to replacement by scrub.

In one of the studies done in a part of present study area, it is found that "early successionals predominate forest and old growth forest are scarce. Unregulated exploitation of forests and faulty management practices seem to be largely responsible for this situation (Singh and Singh 1985). It was stated in 1882, that "formerly the greater part of Dun was covered by the forest of which the prevailing tree was Sal, but of later years much of the forest has disappeared and much of it has been invaded by tall coarse grasses" (Atkinson, 1973).

Thus human activity has had general effect of destroying climax Oak forest and creating conditions for replacing it either with conifers or open thorny shrubs, continued intense interventions destroy most of this shrub and brush growth and creates grassy meadows. At a final stage of forest destruction secondary tree and grass communities are characterized by xerophytic species and species avoided by grazing and browsing animals (Joel, 1966).

Tropical mountain forests are known for their ecological importance; most mountain forests in Ecuador have been converted to agriculture, and those that remain are concentrated on the eastern cordillera. Understanding of land use/land cover change in this ecological zone is inadequate. During the 1990s the region experienced a 0.58 per cent annual rate of deforestation but two areas in it show active signs of afforestation. Although conversion of forest to pasture for cattle grazing contributes, human migration to the United States is likely to affect the trajectory of future land use / land cover change (Brad and Bridget, 2002). Hazardous processes, including floods, land slides, soil erosion, and debris flows, are common in the Himalayas. Deforestation has been held responsible for increasing risk, from such hazards in the Indian context for more than a century. Evidences suggest that the extent of forest cover has altered little over 150 years and that hazardous processes recur in much the same, locations with similar frequency and magnitude, except where road construction has increased slope of instability. Nonetheless, population growth and economic development, especially since 1990, have increased vulnerability to hazards (Gardner, 2002).

Table 4.1(a)

Analysis of forest area based on the Satellite imageries done by forest survey of India

District	Geographical area (sq.km.)	Dense forest (more than 40% crown density	Open forest (between 10-40% crown density)	Total	Forest cover as percentage of Geographical area	Recorded forest area as percentage of geographical area
Dehradun	3088	1239	331.00	1570	50.84	68.55
Uttranchal	53485	17849	5411	23260	43.49	64.81

Source : Uttaranchal Forest Statistics, 2001, Forest Department, Uttaranchal.

The total forest cover which includes dense and open forest is estimated to be 23260 sq.km. This constitutes 43.49 per cent of state's geographical area. Whereas the geographical area of Dehradun district is 3088 sq.km. of which 1570 sq.km area is covered with forest (dense and open forest type) which constitute about 50.84 per cent of total geographical area but the forest area recorded is 68.55 per cent (as shown in Table 4.1(i).

Distribution of Forest

It is observed from the table 4.2(ii) given below, that the average distribution of forest in Dehradun district varies from 69.57 per cent to 66.96 per cent from 1981 to 2001. Where as distribution of groves ranges between 1.44 per cent and 2.09 per cent while the per capita forest share shows a decrease from 0.29 to 0.16 because of increase in population size and decrease in forest cover Chakrata Block has reported highest forest cover in all the three decades while Kalsi Block shows lowest forest cover. In terms of groves distribution, Raipur block shows highest percentage of 5.33 in 2001. Per capita forest share is maximum in Chaktata block because it is less populated block.

Table 4.1(ii)

Percentage Distribution of Forest and Groves and Per capita forest Share in Dehradun District

Blocks		Percentage distribution of forest from reported area	Percentage distribution of groves from reported area	Per capita forest share
Chakrata	1981	78.89	0.22	1.20
	1991	80.84	1.79	0.99
	2001	79.35	0.09	0.84
Kalsi	1981	54.76	0.08	0.39
	1991	59.80	0.80	0.32
	2001	54.53	0.03	0.29
Vikas Nagar	1981	61.49	1.01	0.34
	1991	64.53	0.37	0.25
	2001	65.69	0.43	0.19
Sahaspur	1981	70.34	2.66	0.46
	1991	66.67	1.31	0.32
	2001	68.97	1.85	0.27
Raipur	1981	62.37	4.98	0.07
	1991	59.90	4.00	0.05
	2001	47.13	5.33	0.04
Doiwala	1981	79.96	0.21	0.39
	1991	75.43	0.14	0.23
	2001	75.73	0.31	0.18
Dehradun District	1981	69.57	1.44	0.29
	1991	69.61	1.37	0.21
	2001	66./96	2.09	0.16

Source: Statistical Abstracts of Dehradun District, 1981, 1991 and 2001,Uttaranchal

Forest Cover

It is observed from composite score that out of six blocks of Dehradun district four blocks show negative score and two blocks reveal positive score (Table 4.1(iii). The study concludes that within the Dehradun district the distribution of forest cover has registered the highest composite score in Chakrata block (+0.92) in 2001, where as the lowest composite score has been recorded in Kalsi block (-0.56). In Chakrata

block among the three variables two variables (distribution of forest from reported area and per capita forest share) show the highest scores, one of them show the lowest scores. The topography and climatic conditions are favourable for the growth of forests whereas Kalsi block is mainly an agricultural block which is responsible for the lowest forest growth.

Table 4.1(iii)

Distribution of Forest on the basis of Composite Mean Z-score

Blocks		Distribution of forest from reported area	Distribution of groves from reported area	Per capita forest share	Composite mean Z-score
Chakrata	1981	1.31	-0.73	2.08	0.88
	1991	1.66	0.30	2.17	1.37
	2001	1.25	-0.66	2.16	0.92
Kalsi	1981	-1.46	-0.81	-0.23	-0.83
	1991	-1.03	-0.47	-0.14	-0.55
	2001	-0.95	-0.69	-0.04	-0.56
Vikas Nagar	1981	-0.69	-0.29	-0.37	-0.45
	1991	-0.43	-0.80	-0.38	-0.54
	2001	0.04	-0.48	-0.44	-0.29
Sahaspur	1981	0.33	0.63	-0.03	0.31
	1991	-0.15	-0.07	-0.14	-0.12
	2001	0.33	0.27	-0.12	0.16
Raipur	1981	-0.59	1.94	-1.14	0.07
	1991	-1.02	2.03	-1.07	-0.02
	2001	-1.60	2.12	-1.04	-0.17
Doiwala	1981	1.09	-0.74	-0.23	0.04
	1991	0.97	-0.98	-0.45	-0.15
	2001	0.93	-0.55	-0.48	-0.03

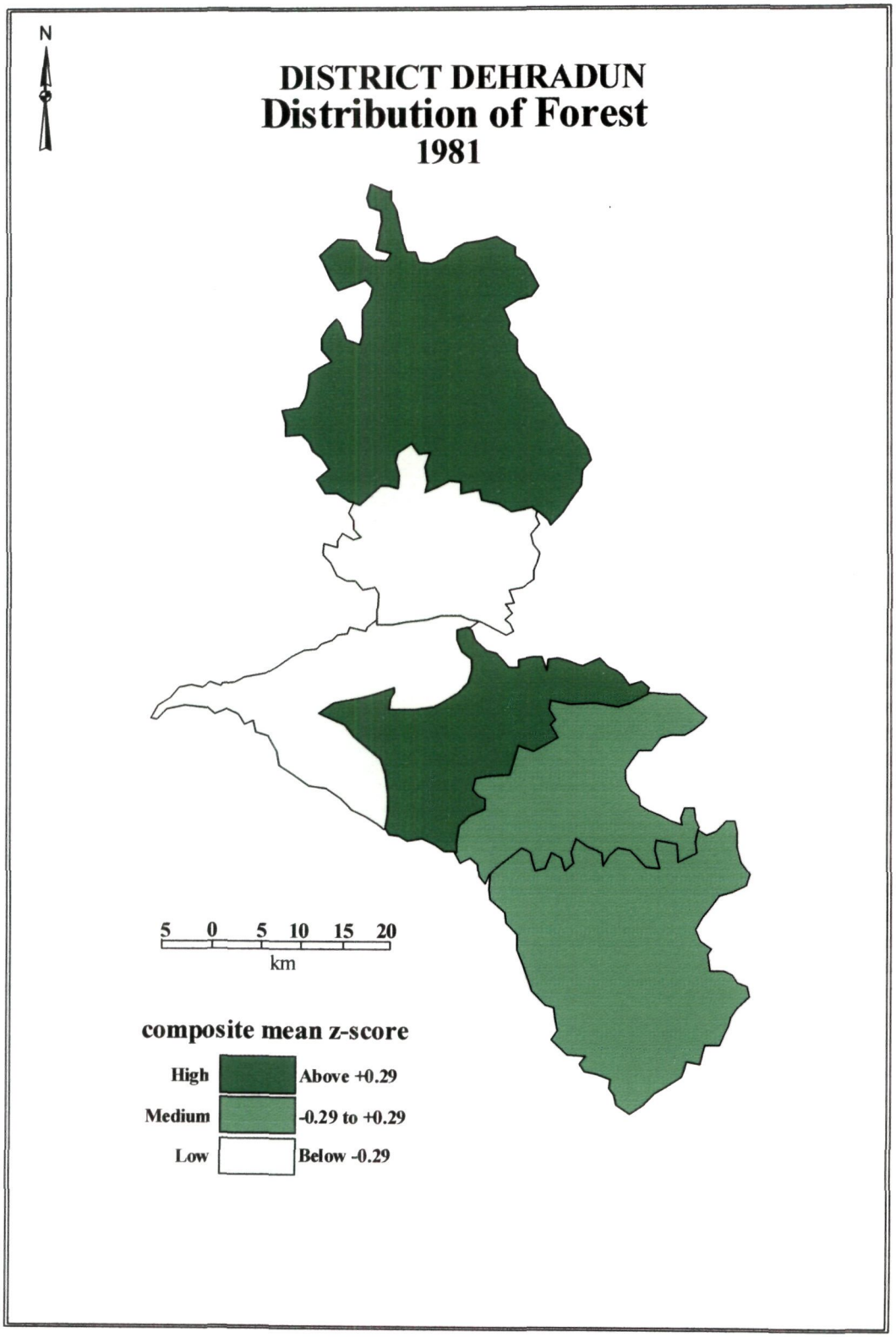

N
DISTRICT DEHRADUN
Distribution of Forest
1981
5 0 5 10 15 20
km
composite mean z-score
High
Above +0.29
Medium
-0.29 to +0.29
Low
Below -0.29

Fig. 4.1(i)

Spatial Distributional Pattern of Forest (1981)

(i) High concentration of forest cover (above +0.29)

This category consists of two blocks namely Chakrata (0.88) and Sahaspur (0.31) Chakrata is located in the upper most portion of the district while Sahaspur block is situated in the central part of the district. Most of the parts of Chakrata block is covered with forests and mountain as well as the per capita forest share in this block is also highest. As far as Sahaspur block is concerned forest cover is high but per capita forest share is not so much high because of its population density.

(ii) Medium concentration of forest cover (+0.29 to -0.29)

Two blocks come under this medium category viz. Raipur (0.07) and Doiwala (0.04). These blocks are located in the Southern portion of the district. In Raipur block the distribution of forest cover is low but the distribution of groves is very much high in comparison to other blocks as shown in Table 4.1(iii), so because of this variable this block comes under the medium grade otherwise the other indicators show negative z-score. As far as Doiwala block is concerned, the distribution of forest cover is high because of its forest canopy while the other indicators show negative z-score.

(iii) Low concentration of forest cover (below –0.29)

Two blocks fall under this low category, they are Kalsi (-0.83) and Vikas Nagar (-0.45). These blocks are situated on the western part of the study area as shown in fig. 4.1(i). These two blocks are basically agricultural blocks because agriculture is the main occupation of these blocks, so the distribution of forest cover is low. More and more forests are being cleared for the cultivation of crops.

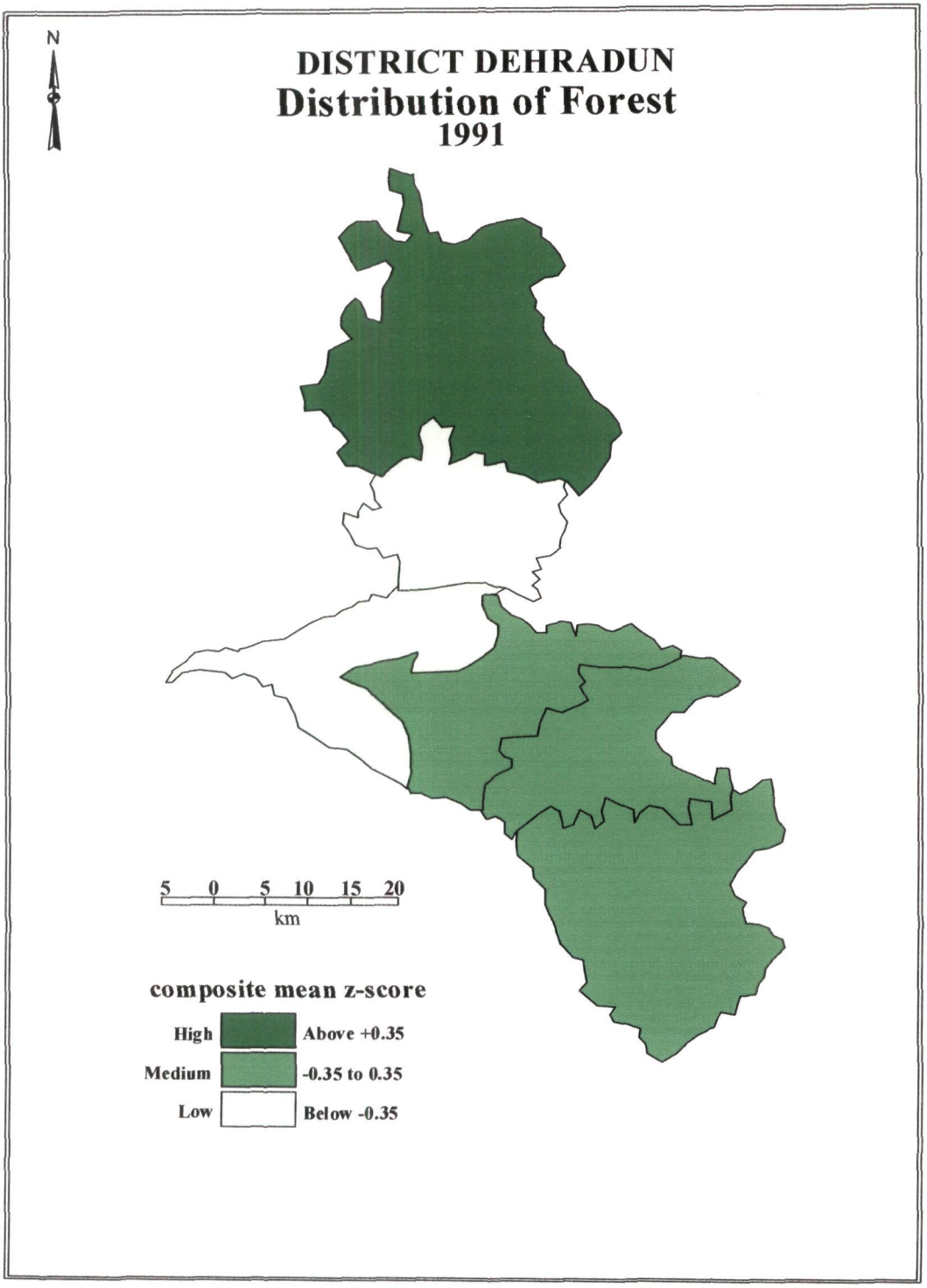

N
DISTRICT DEHRADUN
Distribution of Forest
1991
5 0 5 10 15 20
km
composite mean z-score
High
Above +0.35
Medium
-0.35 to 0.35
Low
Below -0.35

Fig. 4.1(ii)

Spatial Distributional Pattern of Forest (1991)

(i) High concentration of forest cover (above +0.35)

One block i.e. Chakrata (1.37) comes under the high grade of forest cover which is situated on the upper most or northern most part of the district as shown in fig. 4.1(ii). In Chakrata block the distribution of forest as well as the per capita forest share is highest while the distribution of groves is not so high. In 1991, the growth of forest shows a little increase as comparison to 1981 data (Table 4.1(iii)).

(ii) Medium concentration of forest cover (+0.35 to -0.35)

In 1991 three blocks come under the medium grade which forms a continuous belt from central to southern portion of the district as shown in Fig. 4.1(ii), these blocks are Sahaspur (-0.12), Raipur (-0.02) and Doiwala (-0.15). In 1981 the Sahaspur block was under the high grade where as Raipur and Doiwala were in the medium grade.

(iii) Low concentration of forest cover (below –0.35)

Two blocks namely Kalsi (-0.55) and Vikas Nagar (-0.54) come under this low category. In 1981 these two blocks were also in the low category. Kalsi is situated on the southern portion of the northern half while Vikas Nagar block is located on the western part of the central half as shown in fig. 4.1(ii).

Spatial Distributional Pattern of Forest (2001)

(i) High concentration of forest cover (above +0.25)

Only one block i.e. Chakrata (0.92) comes under the high grade as in 1981 and 1991 but the composite mean z-score increases in 1991 from 1981 and decreases in 2001 as shown in Table 4.1(iii). This block has high concentration of forest cover and low concentration of population because of its difficult terrain and topography.

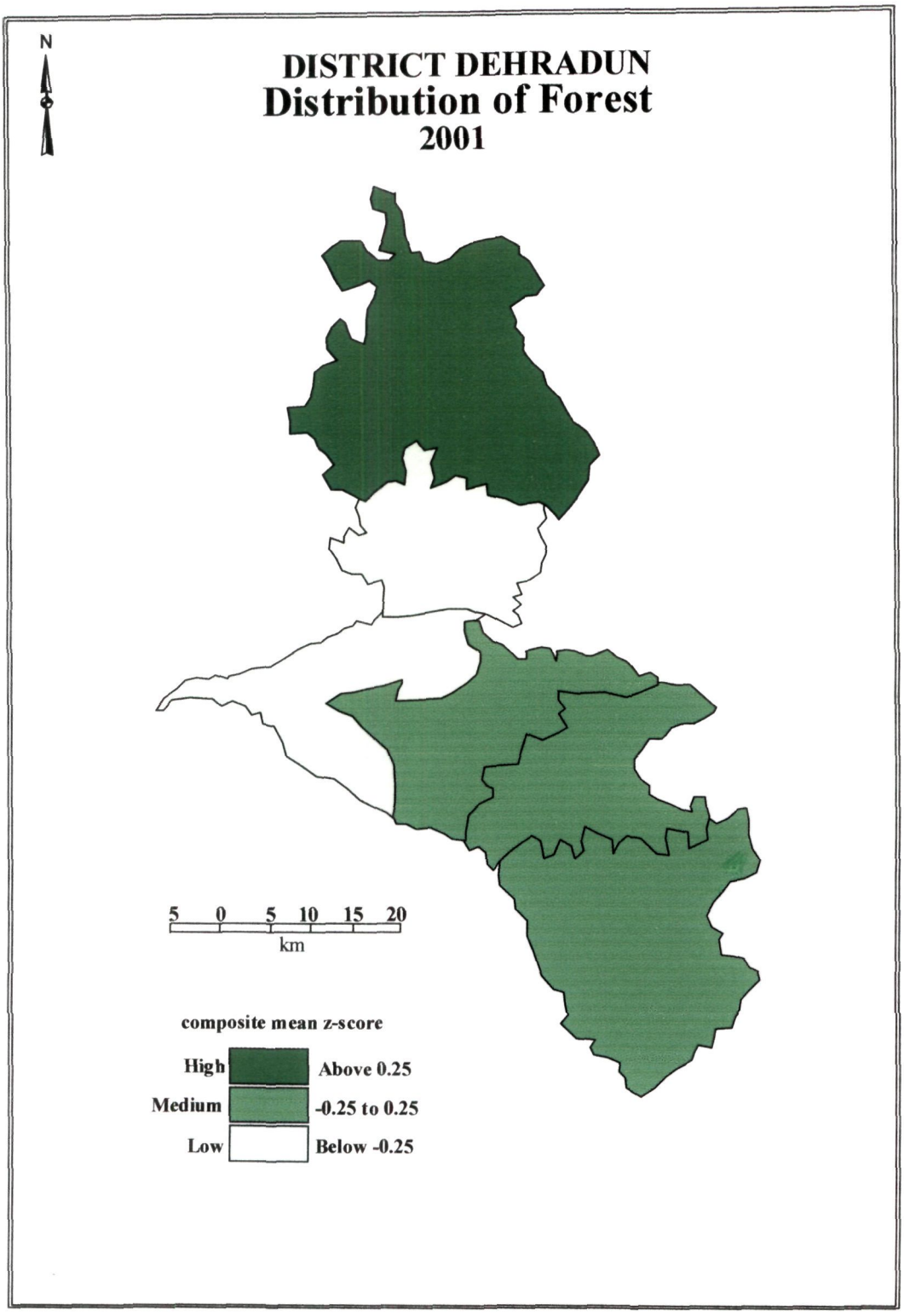

N
DISTRICT DEHRADUN
Distribution of Forest
2001
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.25
Medium
-0.25 to 0.25
Low
Below -0.25

Fig. 4.1(iii)

(ii) Medium concentration of forest cover (+0.25 to -0.25)

Three blocks of Dehradun district fall under this medium category and they are forming a continuous belt from central to southern part of the district as they were making in 1991, except in 1981 one block out of these three blocks were in high grade i.e. Sahaspur block. These blocks are Sahaspur (0.16), Raipur (-0.17) and Doiwala (-0.03) (Table 4.1(iii)). In Sahaspur block the Queen of Hills i.e. Mussorrie hill is the main center of attraction for the tourist so from the last 20 years the tourism industry and development has been taken place so rapidly which is responsible for the degradation of the forest. In Raipur block the urbanization is spreading day by day and this block is highly populated and congested as well as the distribution of groves is much higher than the forest cover. Doiwala block has prominent forest canopy and covered with reserved forests

(iii) Low concentration of forest cover (below –0.25)

Two blocks i.e. Kalsi (-0.56) and Vikas Nagar (-0.29) are in this low category. In 1981 and 1991 they were also in low category, because in these two blocks agriculture is the main occupation and for this purpose more and more land is occupied by cutting down the forest. Therefore, the Agriculture sector is responsible for the degradation of forest in Kalsi and Vikas Nagar block.

Environmental Impact of Forest

It is well known that forests exert a profound influence on land, air and water but their effect is essentially at the micro level. It is on the integration of these micro influences over large areas and over long periods of time which results in macro effects on the environment as a whole.

Air and water are affected through the climatic influences because of the presence of forest cover modifies the climate markedly on a micro level

and to a greater extent on the macro level as the total effect is greater than the some of the parts. The intensity of solar radiation falling on the forest is markedly reduced, and this reduction leads to a modification of temperature and humidity, their vertical gradients, and the soil moisture regions, which in turn, reacts on the nature, density and structure of the vegetation itself. The zone of minimum temperature does not lie at the bottom, but at a height of about 1.5 m and the temperature of the air inside a forest is lower than that prevailing higher up, contrary to what happens in the open where the adiabatic lapse rate is higher, resulting in temperature gradients in the lower layer of the atmosphere. Similarly, the range of the soil temperature is more equable both diurnally and seasonally. It also decreases with the depth of the soil, the main effective zone being up to 30 cm below the soil surface.

Humidity is higher in forest areas, being highest at the ground level at sunrise and as the temperature rises the gradual fall in humidity leads to the transfer of water vapour from the ground by the evening. Dew formation is affected, being more is open, and so are fog and mist which arise from radiation. This is a source of moisture directly absorbed by the leaves. Moisture evaporates less readily, although evapo-transpiration may deplete the soil moisture in a greater extent and to a greater depth, the effect varying with the soil moisture of the forest.

The velocity of wind is, markedly affected, a fact utilized to advantage in the creation of shelter belts and wind breaks. Soil erosion and wind blowing are controlled, the wind induced evaporation is diminished and the vegetation not only acts as a filter and cleanser, especially with respect to soil particles (dust, coal, ash etc) but also to polluting fumes and vapours. The efficiency is directly proportional to the physical structure, but the species also contribute to some extent. The role of vegetation as a producer and replenisher of oxygen needs hardly any emphasis, as virtually all life depends upon the oxygen layer produced and maintained through the functioning of the chlorophyll mechanism interception by tree cover on the average can be

assumed to be around 20 percent of the rainfall (Kaul, 1980). Though no detailed studies have been carried out on interception by the ground vegetation, it is estimated to be atleast 10 percent on a conservative basis. Interception by leaf litter could be of the order of 5 percent of the gross rainfall. Thus, over 35 per cent of rainfall is intercepted by the forest cover. In areas of high rainfall, this reduction assumes greater importance as there will also be a proportionate reduction in run off on the other hand, in areas of low rainfall, water yield calculation should take the forest cover also into consideration for a proper and reliable assessment.

One of the most important functions of forest consists in conditioning the soil to permit to act as a reservoir for water. The forest floor consists of a large amount of decomposing organic matter which changes the physio-chemical properties of the soil.

The effects on the land are perhaps more important in that land degradation is reduced to the minimum and thus condition, compounded with controlled stream-flow, emphasizes the importance of forests as the most efficient means of soil and water managements, especially in areas where other methods of conserving soil and water are not feasible owing to high cost and the present stage of technological development. (Dewan, 1988)

4.2 MINING

Mining may be defined as the removal of minerals from earth's crust for the welfare and prosperity of mankind. Among the bounties of nature, mineral resources are for most valuable treasure to the society marching a head on the road of planning to achieve economic development and growth. Mineral products are beyond doubt backbone of industrialization. A rational utilization and adequate extraction of mineral resources through well directed exploration techniques is, however, an essential prerequisite.

As demands for minerals grow, the area of mining would expand at a faster rate, threatening increasingly larger areas of landscape.

Mineral Wealth

Dehradun and Mussoorie areas are well known for their economic potentiality due to abundance of economic minerals like limestone, limestone marble, phosphorite and gypsum. Other minerals have been also reported either in pockets or in veins like baryte, pyrite, galena and sulphur. All these minerals are located in the Krol belt viz Infra Krol, krol and Tal formations, but their economic potentiality is uncertain as the nature of these deposits are uncertain.

Limestone and Limestone Marble

These minerals are mainly exploited from Krol C member of the Krol Formations in Sahastra dhara, Jud, Kerwan, Oak Grove, Jharipani, Bhatta, Hathipaon and Clouds End area. These limestones are generally dark, pale gray and light bluish in colour, occasionally microcrystalline and hard. They are of high grade passing even into chemical grade. These limestones do have some thin beds of shales. Perfect white and black microcrystalline variety of limestone is also quite common and has given rise to a marble variety of low-grade metamorphism. The limestones are quite pure, the percentage of $CaCo_3$ going as high as 99.8 per cent the concentration varies in streads, pockets and zones of magnesia limestone. High grade limestone in Sisai, Sahastradhara, Bhirtarli, Hathipaon and Clouds End are well known. CaO contents is reported 55 per cent is Sisoli area. The limestones are exposed on the slopes of the ridges and are being worked out by open quarrying and strip mining methods. The over burden is generally very thin, practically one. These deposits extend for 3.5 kms in length all along the southern units of the Mussoorie Syncline. The individual bed of limestone is generally 4-6 meters. Auden estimated the reserves to be approx 34 million tones and regarded them to be of metasomatics origin from the dolomite limestone (Pal and Sah, 1988).

In Dehradun district, Geology and Mineral development work was done by the Uttar Pradesh State Mineral Development Corporation and Directorate of Geology and Mining. During the year 1979-80, 61553 tonnes of high grade limestone was produced by the corporation.

Some of the Impact of Mining

1. **Loss of Forests:** Mining directly affects forests when located in a wooded area. There is loss of timber and fuel resources, useful minor forest produce and loss of habitat for wild life. The vegetation has to be cleared and this results in irregular exploitation of forest contrary to accepted principles of removal of wood equivalent in volume to that of increment put on by forests in a year. Mining also results in loss of genetic resources.

2. **Loss of Agricultural Lands:** Mining invariably, if forests are absent, affects agricultural lands.

3. **Loss of Homes**

4. **Air Pollution:** Mining results in serious disturbances of soil involving digging, transport and dumping. This leads to considerable dust generation at all levels inspite of the provisions of safeguards. Inhalation of the fine dust results in development of pulmonary diseases and the control of dust to be minimized to a great extent if it is possible to totally control it.

5. **Noise Pollution:** In quarries and mines explosives are being used in increasingly large quantities. This generates noise pollution. It also contributes to the destabilization of hill tops by opening out joints, fractures, fissures and cracks. In the Mussoorie hills on an average three blasts per day per quarry (in the eighty odd quarries) have greatly weakened the jointed and already brecciated rocks resulting in acceleration of incidences of mass movements and drying up of spring

feeding the streams such as Kakbare, Derinala, Murry, Dhobighat, Kempty and others (Negi, 1982).

6. **Water Pollution:** Mining some times destroys water sources. The soil is disturbed. In hilly terrain the loosened soil is not only washed downhill chocking water courses or habitations and silting of tanks, reservoirs etc. the wash off soil also result in the raising of river beds and consequent flooding of agricultural, garden lands and villages.

7. **Unplanned Development:** The development of junggis/slums around mining complex is another impact.

8. **Transmission of Power:** Power lines riddle the country side and mining complexes and sometimes involve clearances of forests and trees which produce a dreary atmosphere.

9. **Blasting:** Quarrying locally and in wear forest areas or exavalation of tacking dams causes serious disturbances of soils, loss of vegetation and affect wild life of the forest in nearby.

10. **Infrastructural Facilities:** The construction of roads, establishment of colonies, processing plants, crushers, tackling dams cause destruction of vegetation, loosen the soil, especially in hill regions leading to soil erosion, requiring costly operations like stabilization of slopes and other works.

11. **On Quality of Life:** The establishment of mining industry results in life style of peoples especially tribals and this result in hitherto peaceful inhabitants resorting to fast life especially youth affecting their health (Joshi and Bhattacharya, 1980).

General Issues

Minerals are the foundation of human civilization and the raw materials for every article of human necessity. Besides industrial products, agriculture also depends upon the mineral content of the soil. The concept of

growth governed the mineral industry till the 80's. Since 90's the focus is on sustainable development.

Small scale mining was previously considered to be a wasteful mining due to its unsafe and unhealthy conditions, brutalizing labour practice, and damage to the ecology and environment, while in developing countries the small scale mining is playing a crucial role for the country's economic development, because of their small investment, manageable environmental condition and more direct employment. These are the manifestations of the national concern for rural based strategy and to bridge the resource development in future.

Mining activity in hilly area is quite different from the mining in plain area with respect to all operational and environmental angles. Especially, mining in these areas require special technology to cope with the unique character of the region, such as intensive seismicity, geological and structural setting and other geo-mining conditions. Due to lack of proper planning and other unavoidable reasons, the Himalayan mining system witnessed a drastic amount of environmental degradation and ecological damage. Mining was done in a bottom top fashion proceeding upward from the base of the hill along a steep slope angle, creating large over hangings, which could fail at any moment. During the initial stage of mining, the debris produced water more and was strewn around, to be washed down by rains into rivers, other water regimes and fields because removal was otherwise expensive choked drainage channels caused flash floods. The erosive impact of mining was causing threat to the crops of ginger, paddy, potato and turmeric that are now becoming smaller. Illegal mining also contributed its mite to the debris problem. Instead of using the haulage roads, extracted material were thrown down the slope for collection from the lower roads in order to cut transportation costs. Proper check dams were not constructed to confine debris.

Haulage roads constructed were having steep gradients with no extra width and have quite unsafe curves. Blasting resulted in unstablized zones. As most of the lease holders were given small areas and they did not have the infrastructure facilities, blasting was the only stable operation left with them. According to IBM approved mine plans, they were required to use 32 mm dia drill rods to drill holes of 1.5 m with a spacing of 0.9 – 1.0 m and charge per hole as 140 g. But owing to quick quarry approach miners used to blast using 400-420 g of explosives per hole. In short, while there existed well designed and approved mine plans for most of the small mines, they mainly remained in paper. Actual practice varied widely from the specified guidelines. (Parmar, 1999)

The issue has now become more complex from socio-economic angle because of the disagreement between environmentalists and mine owners. Village communities were also divided, some arguing for badly needed income and others warning of dire consequences from the ecological point of view. Road building and other forms of construction activities were also blamed for creating land degradation in a large scale. In addition, lack of assured facilities for irrigation and need of sufficient rains has made agriculture less lucrative. The per capita income from agriculture was around Rs. 350-400 per month while the earnings from mines were Rs. 2500-3000 per month. The villagers who were directly benefited from the mining activities support the mining whereas those who did not derive any direct benefit were critical of the environmental degradation caused by mining like land degradation, drying up of spring, adverse impact on the fertility of croplands and the overall degradation in the quality of air and water (Parmar, 1999).

Chapter 5

Genetic Environment

Chapter – 5

GENETIC ENVIRONMENT

Natural assemblage of various types of plants and animals (biota) at a particular place make a living or biotic environment It shows variation in type and abundance of species. There are millions of species of plants and animals. Even within a species, there exists enormous diversity. This massive diversity scientifically called as 'Gene Pool' is a heritage that ensures future survival. The process of species diversification started soon after the origin of life on the planet. It is a gradual process influenced by various geophysical and climatic factors, resulting in the emergence of new strains and subspecies. Human beings, at the apex, represent the finest product of evolution. It is no way different or more important than any other species. Collectively all these species are called as genetic resources.

The varied landforms and diverse eco-climatic conditions have adequately expressed themselves in giving rise to a rich natural flora with almost all types of vegetation (Rana, 2003).

5.1 AGRICULTURE

Agricultural land, a farm or a ranch, is a man-managed ecosystem which is scientifically manipulated to achieve maximum sustained productivity. Agriculture has evolved beyond crop culture to become an environmental technology with its prime focus on the management of land (soil), water, air, pest control, fertilizer application, use of high yielding varieties of seeds, crop management and so on. In primitive agriculture, a piece of land was kept under cultivation for some years depending upon the fertility of the land. Shifting activation and sloping land initially gave good yields but led to soil erosion. People moved to new areas after converting fertile land to degraded waste land. This was possible because abundant land was available. But with the population explosion, the situation changed. Since agricultural

land is limited, modern agro techniques are now practiced to increase the productivity.

The basic resources for agriculture are sunlight, soil and water. In a 12 hour day, about 500 kcal cm^2 of solar energy is available on earth and one estimate indicates that about 45% of it is utilized in photosynthesis. It has been estimated that about 140 tonnes of crop yield per hectare per year is possible in India, but in practice, only about 18% of this theoretical maximum (25 tonnes per hectare per year) has been achieved in some fertile lands. Soil is a very important resource as it takes a long time to form. It has been estimated that every year about 6,000 million tones of soil are washed away by soil erosion worldwide (Rana, 2003).

Soil erosion and the improper use of soil need to be checked so that the crop yield increases. Indian agriculture depends largely on the monsoon as the country has only 40 million hectares of cultivable land. The annual rainfall is about $370x10^4$ million m^3, of which the southwest monsoon brings in 80 per cent (Rana, 2003).

Of the total of 329 million hectares of land in India, about 142 million are under cultivation. Of India's net national product of Rs. 1,732,000 million, agriculture contributes about 33%. In recent years there has been a wasted increase in crop productivity due to genetic manipulation, use of fertilizers, pest control methods, mechanization and sound ecological methods. Two to three crops have now become possible on the same land due to good irrigation and the use of short duration growth plants (genetic manipulation). Rice is the main cereal, accounting for about 80% of the cultivated area. Wheat is the most important rabi crop. The main pulses in India are the pigeonpea or arhar, which contains about 22.3% protein. Soyabean, which contains 43.2% protein, is now grown widely, the other important crops are oil seeds, sugar crops, fibre crops, potato and other tuber crops and plantation crops like tea, coffee, cocoa, rubber, coconut, cardamom, black pepper and other spices. India produces about 15 million tonnes of fruits from 2 million hectares and 9 million tonnes of

vegetables per year from 1 million hectare. Sharma (1987) estimates that under ideal conditions, the annual global production is adequate for feeding 6 billion individuals. Efforts are now being made all over the world to increase production by using biotechnological methods, and putting a lot of auxiliary energy into agricultural fields.

However, the crop yield varies from region to region depending upon the climatic factors, technological inputs and management strategies used. Modern agricultural practices also create serious pollution problems. Agricultural lands need to be concerned from degradation and efficient management practices need to be followed (Rana, 2003).

Agriculture is the chief source of livelihood for millions of people in the world as well as in India. Agricultural development is central to all strategies of planned socio-economic development in India. Spectacular break-through in agricultural research technology, development and dissemination under the umbrella of Green Revolution have been major factor in increasing both agricultural production and productivity. The prospect of agricultural development solely depends upon the past trends. The socio-economic factors, the regional institutional set up and natural factors varying over geographical contour together provide a climate for a particular nature of agricultural development framework. Agricultural development begins about social and cultural development due to an increase in per capita income. There is an over all improvement in the quality of life which gets expression in the level of education, health care, better housing and so on. The cultivators are able to make use of technology and go for the improved method of farming. The first important work on problems and prospects of agricultural development in India, is the Report of the Royal Commission on Agriculture (1928) which provides an exhaustible report on many problems which are responsible for the agricultural backwardness in India, suggestions for the improvement of agricultural situations have also been given. Banerjee (1969) suggested that the future of Indian Agriculture depends on the adaptation of the adequate strategy

in agricultural planning based on comprehensive assessment in agricultural resources potentially in social and economic infrastructure and their possible impact on the country as a whole. Kanwar (1970) has focused attention of the modernization of Indian Agriculture. According to him the productivity of agriculture is based on the use of HYV seeds, chemical fertilizers, scientific water management and other practices. These are the suitable components of the progress and modernization of Indian Agriculture. Pal (1975) in his study found out the agriculture being the prominent sector of economy. The pace of economic development of the country has been and still continues to be significantly influenced by the pace of its agricultural development. Infact several eminent scholars have explained the spatio-temporal variations in agricultural development. (Mitra, 1967; Mellor, 1967; Nath, 1969; Sharma, 1971; Alam, 1974; Shenoi, 1975; Mohammad, 1979; Srivastava, 1983; Mohammad, 1992). They all have tried to understand the pattern and processes of the crucial problem of agricultural development as it is a multidimensional concept.

Above all agricultural development should not produce deterioration in ecological conditions. It should not lead to defacement of forest, exhaustion of soil nutrients, depletion of underground water and emergence of water logging conditions. Conservation of physical resources is an integral part of any agricultural development (Gopal Krishnan, 1992).

The following eight indicators have been selected for measuring agricultural development in the study region, considering the theoretical constructs of agriculture:

1) Cropping intensity
2) Percentage area under food grain to gross cropped area.
3) Irrigation intensity
4) Percentage of canal irrigation to net irrigated area.
5) Consumption of NPK (in kg) per hectare in gross cropped area.
6) Percentage of agricultural workers to total main workers

Table 5.1(i)

Agricultural Development in Dehradun District

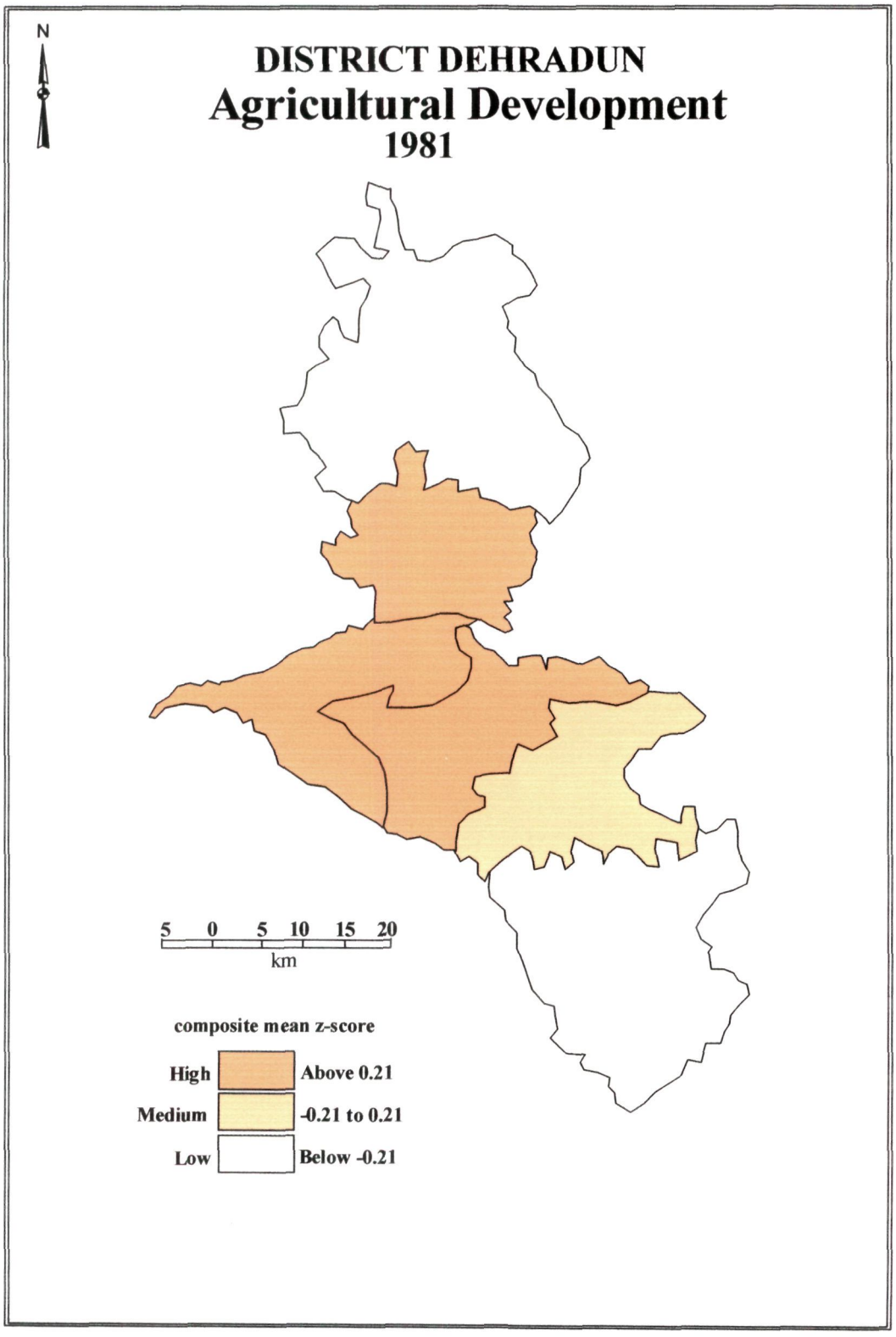
Blocks		Cropping intensity	Percentage area under foodgrains to GCA	Irrigation intensity	Percentage of canal irrigation to NIA	Consumption of NPK(kg)/ ha of GCA	Percentage of agri. Workers to total main worker	Rural literacy rate	Per capita production of foodgrains in kg
Chakrata	1981	147.60	79.20	167.00	2.90	5.60	87.89	16.00	323.00
	1991	145.71	78.69	189.31	11.55	5.86	81.05	27.38	287.11
	2001	154.22	70.41	159.09	03.45	10.37	76.41	47.99	240.47
Kalsi	1981	182.10	84.80	156.40	74.10	7.40	85.54	24.50	290.00
	1991	155.13	81.91	178.89	41.47	7.29	79.55	38.05	283.50
	2001	174.25	85.11	181.75	29.60	18.36	82.27	57.55	295.05
Vikas Nagar	1981	162.40	76.70	175.40	83.50	31.20	56.80	34.40	237.00
	1991	192.01	74.87	190.20	64.74	56.24	59.41	46.08	181.54
	2001	171.29	71.93	169.64	82.10	64.39	36.49	65.08	152.00
Sahaspur	1981	175.30	81.00	208.30	52.80	26.40	40.24	43.20	267.00
	1991	172.55	75.66	187.45	39.71	47.65	37.28	62.38	143.81
	2001	134.87	75.83	129.57	36.22	62.24	24.32	75.19	134.44
Raipur	1981	147.50	71.60	155.80	81.90	44.70	8.93	49.60	160.00
	1991	160.49	72.85	171.66	66.93	73.30	7.82	71.20	26.02
	2001	120.59	65.70	128.89	64.30	69.83	4.43	78.20	19.96
Doiwala	1981	129.00	65.40	112.30	34.10	82.80	25.62	49.90	138.00
	1991	185.88	68.87	139.37	35.74	74.61	36.23	70.46	103.71
	2001	143.72	66.28	143.16	61.02	80.57	16.94	79.19	70.48
District	1981	155.30	76.70	152.40	55.30	32.90	34.19	36.30	223.00
	1991	170.69	74.87	167.93	46.94	47.77	31.93	57.57	101.26
	2001	148.27	72.36	145.58	58.07	56.41	21.81	70.50	81.38

Source : Statistical Abstracts of Dehradun District 1981,1991and 2001, Uttaranchal.

Table 5.1(ii)

Agricultural Development on the basis of composite mean z-score

Blocks		Cropping Intensity	Percentage area under foodgrains to GCA	Irrigation intensity	Percentage of canal irrigation to NIA	Consumption of fertilizer in kg/ha on GCA	Percentage of agri. Workers to total main workers	Rural literacy rate	Per capita production of foodgrain in kg.	Composite index
Chakrata	1981	-0.54	0.43	0.15	-1.76	-1.05	1.27	-1.59	1.29	-0.22
	1991	-1.39	0.78	0.74	-1.70	-1.36	1.18	-1.52	1.24	-0.25
	2001	0.23	-0.32	0.35	-1.64	-1.52	1.23	-1.67	0.94	-0.30
Kalsi	1981	1.37	1.31	-0.21	0.67	-0.98	1.19	-0.93	0.85	0.41
	1991	-0.82	1.55	0.15	-0.10	-1.31	1.13	-0.87	1.20	0.12
	2001	1.28	1.91	1.49	-0.64	-122	1.43	-0.84	1.53	0.62
Vikas Nagar	1981	0.28	0.04	0.45	1.01	-0.07	0.20	-0.15	0.02	0.22
	1991	1.42	-0.14	0.79	1.14	0.43	0.35	-0.39	0.11	0.46
	2001	1.12	-0.09	0.88	1.39	0.50	-0.12	-0.18	-0.001	0.44
Sahaspur	1981	0.99	0.71	1.60	-0.07	-0.25	-0.36	0.55	0.46	0.45
	1991	0.24	0.04	0.64	-0.19	0.12	-0.49	0.59	-0.29	0.08
	2001	-0.78	0.50	-1.12	-0.38	0.42	-0.54	0.69	-0.19	-0.17
Raipur	1981	-0.54	-0.76	-0.23	0.95	0.45	-1.43	1.05	-1.13	-0.20
	1991	0.49	-0.63	-0.25	1.26	1.03	-1.63	1.12	-1.55	-0.02
	2001	-1.53	-1.04	-1.19	0.70	0.71	-1.22	0.95	-1.41	-0.50
Doiwala	1981	-1.57	-1.73	-1.76	-0.73	1.91	-0.86	1.07	-1.45	-0.64
	1991	1.05	-1.59	-2.08	-0.41	1.08	-0.54	1.08	-0.72	-0.26
	2001	-0.32	-0.95	-0.44	0.57	1.11	-0.79	1.04	-0.87	-0.08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DISTRICT DEHRADUN
Agricultural Development
1981
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.21
Medium
-0.21 to 0.21
Low
Below -0.21

Fig. 5.1(i)

7) Rural literacy rate

8) Per capita production of food grain in Kg

Agricultural development is a multidimensional process. It is a key element of rural development. There is a legitimate aspiration of the people in rural areas to improve their standard of living and to share the fruits of development. The primary objective of agricultural development is usually to increase the growth of agricultural output. It is a requisite of an economic growth. Nevertheless, the extent of utilization of agricultural potential and the levels of development attained vary from block to block (on the basis of composite mean z score of the eight indicators).

Spatial Distributional Pattern of Agricultural Development (1981)

(i) High Levels of Agricultural Development (above +0.21)

This category consists of three blocks, viz. Kalsi (0.41), Sahaspur (0.45) and Vikas Nagar (0.22). These blocks form a continuous belt in the central part of the district as shown in fig. 5.1(i).

(ii) Medium Level of Agricultural Development (+0.21 to –0.21)

The medium level category comprises of only one block i.e. Raipur (-0.20) which is located in the southcentral part of the district.

(iii) Low Level of Agricultural Development (below –0.21)

Only two blocks come under this category: they are, Chakrata (-0.22) and Diowala (-0.64). Both the blocks are located in the extreme positions, Chakrata block is located in the northern most part and Diowala in the extreme south portion of the district.

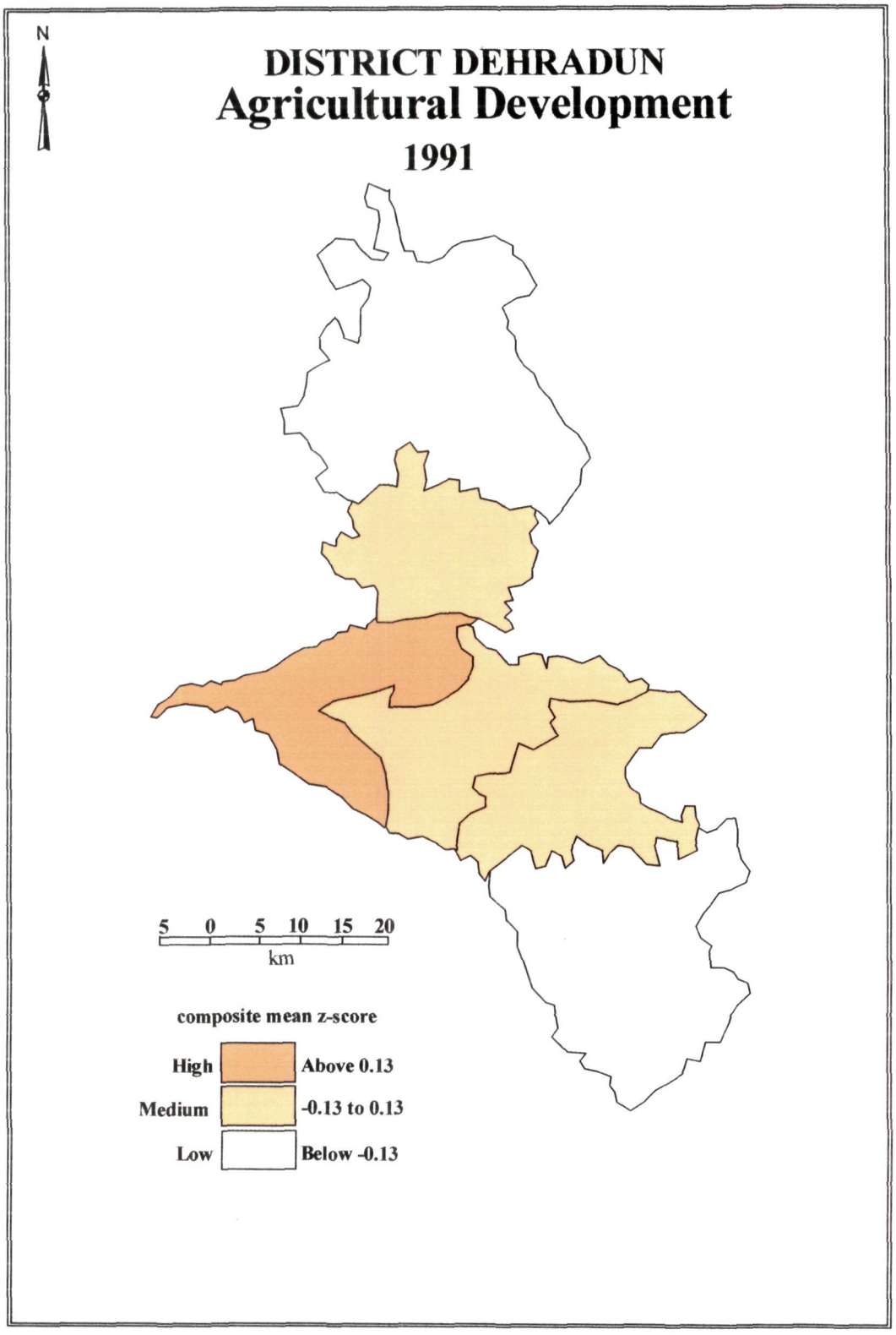

N
DISTRICT DEHRADUN
Agricultural Development
1991
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.13
Medium
-0.13 to 0.13
Low
Below -0.13

Fig. 5.1(ii)

Spatial Distributional Pattern of Agricultural Development (1991)

(i) High Level of Agricultural Development (above +0.13)

In 1991 this category consists of only one block i.e. Vikas Nagar (0.46) which is located in the western part of the district while in 1981, three blocks were come under this high category.

(ii) Medium Level of Agricultural Development (+0.13 to –0.13)

Three blocks of the district lie in this medium category. Two of them lie in the central part, they are, Sahaspur (0.08) and Raipur block (-0.02) and one lie in the upper central part of the district i.e. Kalsi block (0.12) as shown in fig. 5.1(ii).

(iii) Low Level of Agricultural Development (below –0.13)

Two blocks come under this low category of agricultural development in 1991 as observed in 1981. They are Chakrata (-0.25) and Doiwala blocks (-0.26). The composite score of these blocks is more or less same as shown in Table 5.1(ii). Both the blocks are located in the extreme portions of the district; one in northern most part while other in southern most part of the district (Fig. 5.1(ii).

Spatial Distributional Pattern of Agricultural Development (2001)

(i) High Level of Agricultural Development (above +0.22)

In 2001 two blocks lie in this category namely, Kalsi (0.62) and Vikas Nagar (0.44) which form a prominent area in the west central part of the district. Vikas Nagar attained the high level of agricultural development in all the three decades. While Kalsi block enjoys high level of agricultural development in 1981 and 2001 while it was in the medium grade in 1991.

(ii) Medium Level of Agricultural Development (+0.22 to –0.22)

Two blocks come under this medium category namely, Sahaspur block (-0.17) and Doiwala (-0.08) while in 1981 Sahaspur block was under the high

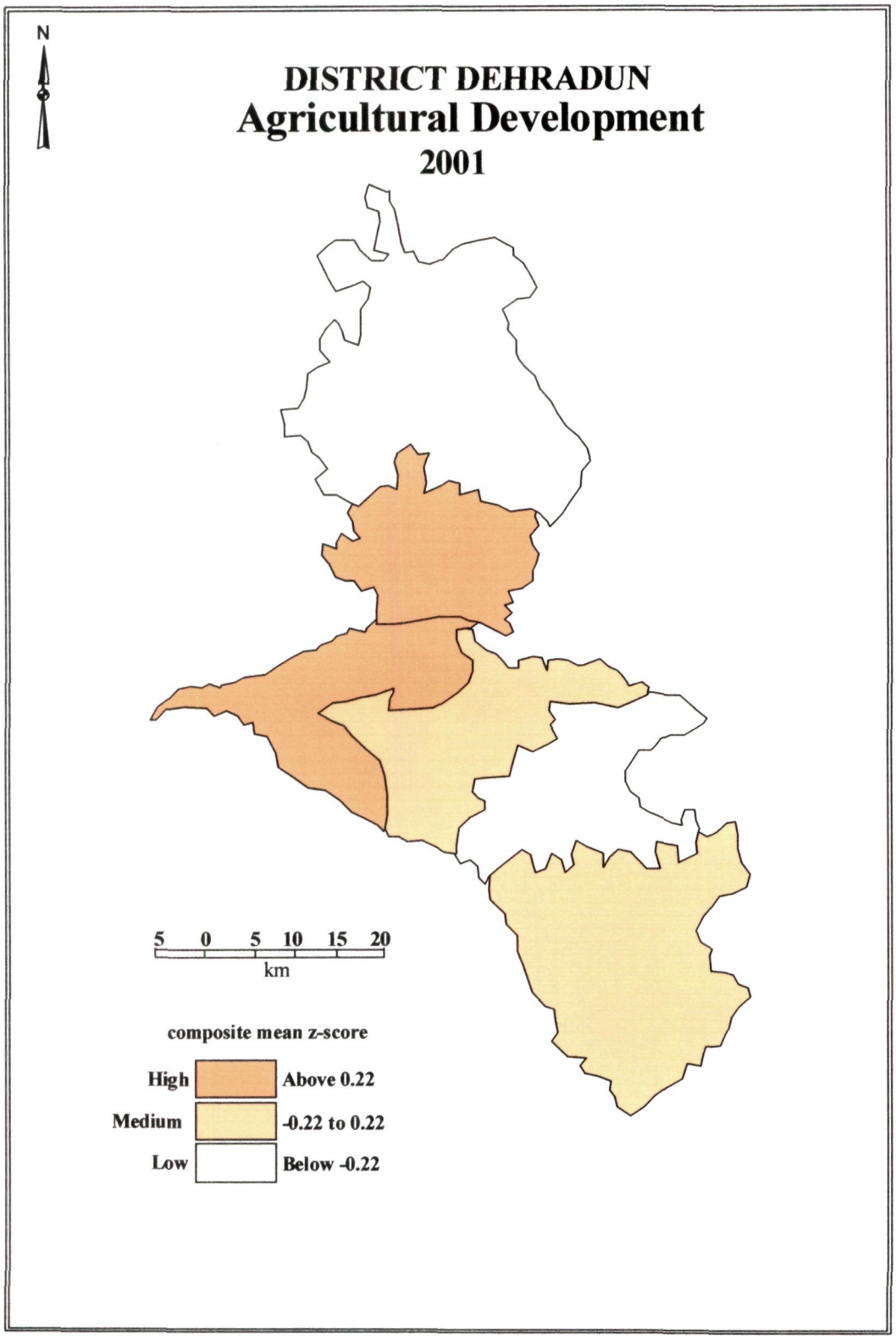

N
DISTRICT DEHRADUN
Agricultural Development
2001
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.22
Medium
-0.22 to 0.22
Low
Below -0.22

Fig. 5.1(iii)

grade (0.45), and in 1991 it came under the medium grade (0.08) . This block shows a decrease in agricultural development (Table 5.1(ii) whereas Doiwala block is concerned; this block was under the low grade in both the years of 1981 and 1991 but in 2001 it is under the medium grade. It shows an increase in agricultural development (Fig. 5.1(iii).

(iii) Low Level of Agricultural Development (below –0.22)

Two blocks come under this low category viz, Chakrata (-0.30) and Raipur (-0.50) Table 5.1(ii). Previously Raipur block was under the medium grade in 1981 and 1991 respectively but in 2001 the agricultural development decreased. Factors like urbanization and industrialization affect the agricultural development of this block.

Thus it is observed that even after twenty years there is a little change in the spatial pattern of blocks having high level of development which form a cluster in the upper central portion, medium level also covers the central portion belt in 2001, it also covers the southern most part of the district. While the blocks with low level of development are found in the northern most part and southern most part except in 2001.

The blocks recording high level of agricultural development have attained their status due to a variety of reasons. The farmers living in the central portion enjoy better irrigation facilities, cropping intensity is high, availability of agricultural workers and more production of food grains etc.

The medium level is also found in the central part for the years 1981, 1991 & 2001. The irrigational facilities and agricultural workers are also lacking.

The blocks in low level category are in the upper and lower part of the district. This area is lacking in cropping intensity, irrigation intensity and percentage area under food grains.

5.2 LIVE STOCK

Live stock keeping in India and similar other countries have multiple objectives and dimensions. This play multiple roles in rural systems and economy and have a strong human dimension, as manifested through socio-cultural risk and involvement of women (Maki-Hokkonen, 1996). Besides their well established role in agriculture livestock have crucial role in food security and as risk aversion mechanism for sustaining family, whenever there is crop failure. Role of livestock in generating employment and income in rural areas is well established and livestock development has become an important component of rural development programs i.e. "Equity and extending benefits directly to women" can be achieved through livestock development, since livestock distribution is less skewed than land. Livestock are a part of nature's chain for recycling nutrients, converting low quality and other agro-bye products into good quality and organic fertilizer. The latter being important for retaining soil fertility and productivity in ecologically fragile hill region. Moreover the farmers always take holistic view and are good example of systems manager who has to make decision on variety of factors.

Improved livestock management by small land holders would contribute to farm income, household nutrition and sustainability of livestock production. Mixed farming will be the choice of farmers in the hill agro ecosystem as livestock is an inseparable component of hill agriculture (Chander and Mukherjee, 1995).

Livestock Structure

The livestock form the farm force in Dehradun district. Almost all agricultural operations starting from the ploughing of land to the carting are performed by the livestock. It is a keystone in the farming and an integral part of the agricultural economy (Singh, 1986). The livestock consist of the draught as well as of the milch cattle. The bullock and the equestrians are included in the draught animal while the cow, buffalo and goat are the milch animal. But in

Table 5.2(i)

Livestock Structure in Dehradun District (in Percent)

S.No.	Blocks	Milch animal (cattle + buffaloes)	Oxen (cattle & buffaloes)	Equestrians	Sheep	Goat	Pig	Poultry	Total livestock
1.	Chakrata	42.05	31.48	2.29	4.00	19.25	0.69	0.24	46351
2.	Kalsi	42.77	33.30	1.89	2.47	18.69	0.47	0.41	35214
3.	Vikas Nagar	62.58	28.56	0.84	0.29	5.64	0.48	1.60	32338
4.	Sahaspur	68.26	20.98	0.68	0.47	2.54	0.42	6.63	30385
5.	Raipur	70.73	22.85	0.64	0.51	3.76	0.60	0.90	20872
6.	Doiwala	79.39	15.35	0.75	0.31	1.76	0.46	1.97	31400
	District	58.62	26.21	1.31	1.61	9.89	0.53	1.83	196560

Source : Statistical Abstract of Dehradun District, 2001. Uttaranchal.

this study, Goat is not included in the milch animal because of lack of data regarding goats. Besides, the piggery and poultry are practiced to produce meat for the non vegetarian population of the district. The sheep rearing is meant for producing wool. This is a source of livelihood in a large number of the shepherds in the region.

The livestock structure Table 5.2(i) has been compiled according to the recommendations of the Indian council of Agricultural Research regarding conversions of the number of livestock into units of livestock. In this conversion bullock, buffalo and cow have as many units as they will number while 6 goat, 7 sheep and 100 poultry will be equal to one unit each. (Singh, 1975)

An interpretation of the Table 5.2(i) will provide an idea of the livestock association in Dehradun district. In this association, only a little less than 59 per cent is shared by the milch animals, of which cow and buffalos are the principal constituents. The second order of strength is that of the bullock, which is little over 26 per cent of the total strength of livestock in the district. The third dominant category is of the goat which claims a little less of 10 per cent of the total livestock. Thus, the remainders all such as equestrians, sheep, pig and poultry as constructed together to more than 5 per cent of the total livestock.

It is evident from the strength of the different types of livestock that the milch animals for both, the domestic and commercial purpose are given priority in domestication. They provide milk, curd, ghee and butter specially to the vegetarian population of the district.

The next dominant category is of the bullock which plays very significant role in the economy of the district. Since, a large number of operation are performed by the bullock who can alone work in the fields which are extremely fragmented and scattered far and wide from the homestead. Besides for a number of other purposes such as in cart driving and tyre-cart

driving, the bullock is the main draught force in the district. Other equestrians like horses, mule , donkey, elephant, camel are there in the district but together their strength in only 1.31 per cent.

The goat is a small animal, sold at a very low prices. Its contribution to the economy however is very valuable. For the poor people it brings a dependable income in the district. It provides delicious meat. Its milk is of exceptional value from health point of view.

Block to block variations in the percentage strength of the different livestock types are discernible from the Table 5.2(i). The milch cattle claim sizeable strength in Doiwala block (79.39 per cent) followed by Raipur block (70.73 per cent). It appears that the demand for milk and other products in Doiwala town and its surrounding makes the rearing of milch cattle a profitable enterprise. In rest of the blocks, the strength of milch animal ranges from 42 to 68 per cent.

The percentage strength of bullock also varies from block to block, albeit the variations are minor in Kalsi, Chakrata and Vikas Nagar, wherein bullock claim 33.30 per cent, 31.48 per cent and 28.56 per cent of the total strength of livestock respectively. In Doiwala block the percentage strength of bullock is very low (15.35 per cent).

The goat by comparison is more dominant in Chakrata (19.25 per cent) and Kalsi (18.69 per cent). The extensive diaraland in Chakrata block and in the adjoining other block of the district provide vast expense of grazing land. As such, the goat and sheep are reared with grazing facilities available.

Table 5.2(ii)

Distribution of Livstock in Dehradun District

Blocks		Number of livestock per ha. of total area	Number of livestock per person	Number of cattles per ha. of cultivated area	Number of cattles per person	No. of poultry per ha. of total area	No. of poultry per person
Chakrata	1981	2.12	1.91	3.68	0.74	0.15	0.14
	1991	2.11	1.58	3.83	0.61	0.15	0.11
	2001	3.02	1.97	5.72	0.68	0.26	0.17
Kalsi	1981	1.76	1.66	3.06	0.54	0.27	0.25
	1991	1.75	1.37	3.18	0.45	0.26	0.21
	2001	2.21	1.61	4.78	0.51	0.35	0.26
Vikas Nagar	1981	1.01	0.58	2.23	0.28	0.77	0.44
	1991	1.02	0.43	2.40	0.21	0.77	0.32
	2001	1.32	0.45	3.16	0.21	1.03	0.35
Sahaspur	1981	0.81	0.59	2.68	0.29	0.83	0.60
	1991	0.81	0.40	2.63	0.20	0.83	0.42
	2001	0.83	0.37	2.65	0.19	2.89	1.29
Raipur	1981	0.67	0.11	3.04	0.06	0.24	0.04
	1991	0.67	0.09	3.03	0.04	0.24	0.03
	2001	0.96	0.07	2.73	0.04	0.31	0.03
Doiwala	1981	1.46	0.56	3.11	0.25	0.70	0.27
	1991	1.46	0.36	2.81	0.16	0.70	0.17
	2001	1.45	0.27	3.31	0.13	1.34	0.25
District	1981	1.21	0.49	2.93	0.21	0.52	0.21
	1991	1.21	0.36	2.94	0.16	0.52	0.15
	2001	1.46	0.35	3.56	0.15	1.16	0.28

Source : Statistical Abstracts of Dehradun District, 1981, 1991, 2001, Uttaranchal

Table 5.2(iii)

Livestock on the basis of composite mean z-score

Blocks		Number of livestock per ha. of total area	Number of livestock per person	Number of cattles per ha. of cultivated area	Number of cattles per person	Number of poultry per ha. of total area	Number of poultry per person	Composite index
Chakrata	1981	1.44	1.42	1.48	1.58	-1.13	-0.75	0.67
	1991	1.45	1.44	1.70	1.57	-1.13	-0.71	0.72
	2001	1.83	1.64	1.77	1.77	-0.84	-0.54	0.94
Kalsi	1981	0.81	1.07	0.19	0.75	-0.73	-0.20	0.31
	1991	0.80	1.09	0.40	0.81	-0.76	0.00	0.39
	2001	0.76	1.14	0.94	1.00	-0.74	-0.32	0.46
Vikas Nagar	1981	-0.51	-0.45	-1.56	-0.33	0.93	0.75	-0.19
	1991	-0.50	-0.44	-1.16	-0.33	0.93	0.78	-0.12
	2001	-0.41	-0.47	-0.49	-0.36	0.00	-0.09	-0.30
Sahaspur	1981	-0.86	-0.44	-0.60	-0.29	1.13	1.55	0.08
	1991	-0.87	-0.49	-0.70	-0.38	1.13	1.50	0.03
	2001	-1.05	-0.58	-0.95	-0.45	2.02	2.19	0.19
Raipur	1981	-1.10	-1.11	0.14	-1.25	-0.83	-4.30	-1.41
	1991	-1.12	-1.00	0.10	-1.14	-0.83	-1.28	-0.88
	2001	-0.88	-1.00	-0.88	-1.13	-0.78	-0.88	-0.92
Doiwala	1981	0.28	-0.48	0.29	-0.46	0.70	-0.10	0.04
	1991	0.28	-0.56	-0.34	-0.57	0.70	-0.28	-0.13
	2001	-0.24	-0.72	-0.36	-0.73	0.34	-0.34	-0.34

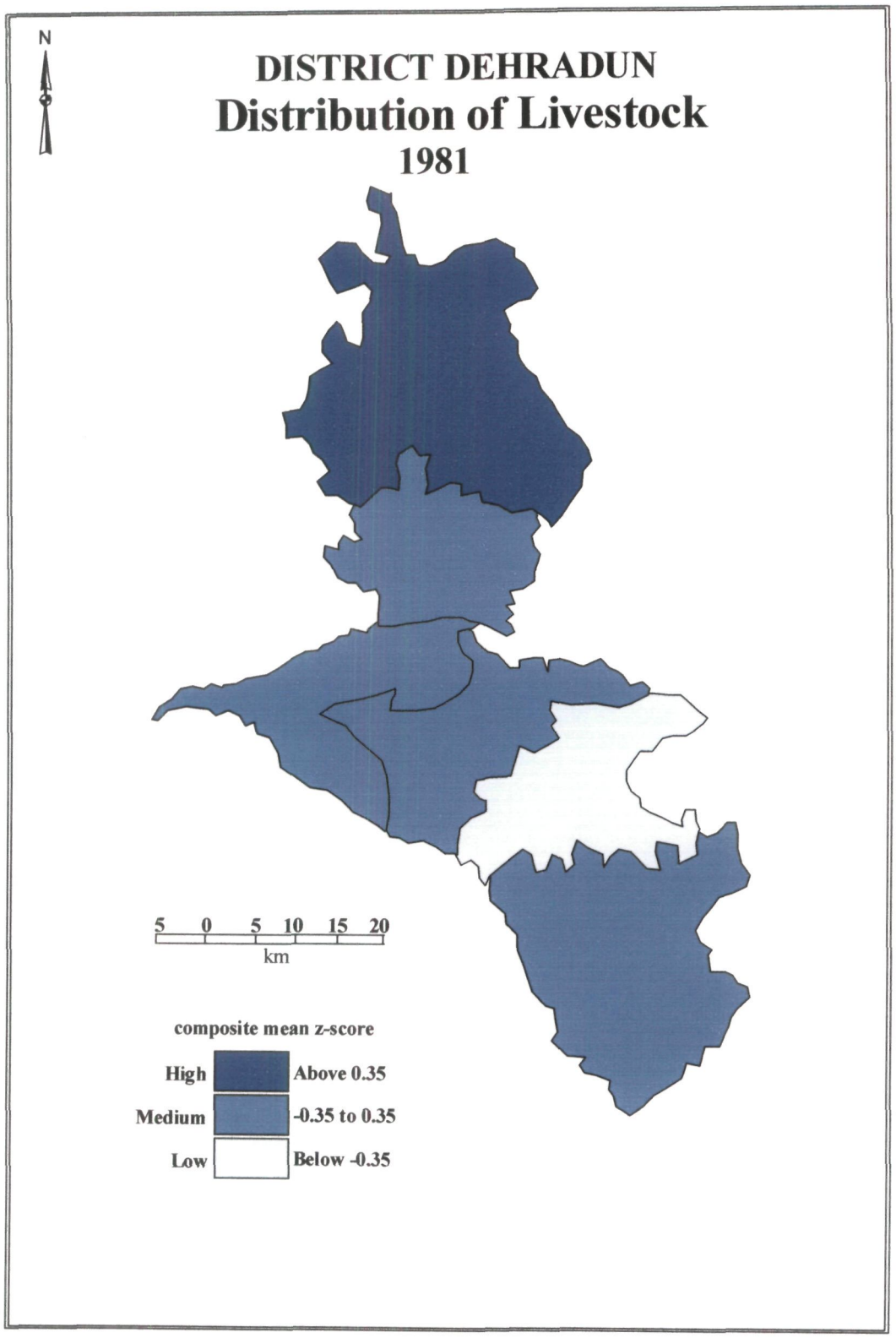

N
DISTRICT DEHRADUN
Distribution of Livestock
1981
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.35
Medium
-0.35 to 0.35
Low
Below -0.35

Fig. 5.2(i)

Spatial Pattern of Livestock Development (1981)

(i) High level of Livestock Development (above +0.35)

This category consists of one block viz. Chakrata (0.67) as shown in Table 5.2(iii). This block is located in the northern part of the district (fig. 5.2(i). Chakrata block record high level of livestock due to a variety of reasons like the number of livestock per hectare of total area and number of livestock per person is more as well as number of cattles per hectare of cultivated area and per person is also prominent but the position of poultry is not strong in this region.

(ii) Medium Level of Livestock Development (+0.35 to –0.35)

Four blocks come under this medium category, namely, Kalsi (0.31), Vikas Nagar (-0.19), Sahaspur (0.08) and Doiwala (0.04). Kalsi is located in the north of the district, Vikas Nagar is situated in the westertn part while Sahaspur covers the central part and Doiwala lie in the southern part of the district. In Kalsi block, number of livestock per hectare of total area, number of livestock per person, number of cattles per hectare of cultivated area and number of cattles per person are strong while the poultry per hectare of total area as well as number of poultry per person is weak. While Vikas nagar block shows positive z-score in term of number of poultry per hectare of total area and number of poultry per person. Table 5.2(iii).

(iii) Low Level of Livestock Development (below –0.35)

This low category comprises of one block i.e. Raipur (-1.41). Raipur is situated in the central part of the district. In the blocks most of the variables show negative z-score. So the concentration of livestock in this block is not prominent.

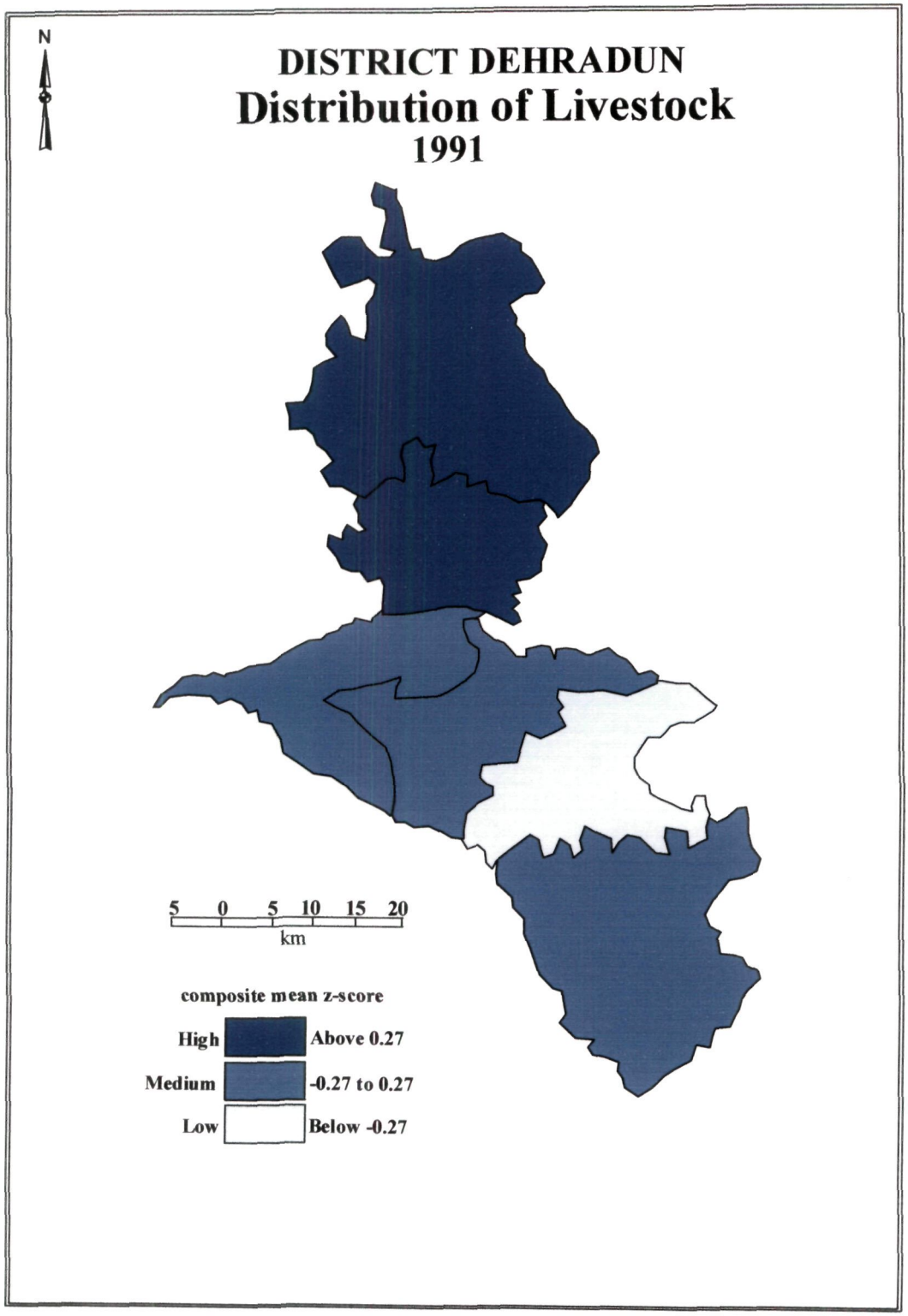

N
DISTRICT DEHRADUN
Distribution of Livestock
1991
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.27
Medium
-0.27 to 0.27
Low
Below -0.27

Fig. 5.2(ii)

Spatial Pattern of Livestock Development (1991)

(i) High level of Livestock Development (above + 0.27)

This high category consists of two blocks, namely, Chakrata (0.72) and Kalsi (0.39). These block cover the upper part of the study area. They record an increase in composite z-score from the scores of 1981. In 1981 only Chakrata block was under the high grade as shown in Table 5.2(iii).

(ii) Medium Level of Livestock Development (+0.27 to –0.27)

In 1991 three blocks, namely, Vikas Nagar (-0.12), Sahaspur (0.03) and Doiwala (-0.13) come under the medium category. Vikas Nagar and Sahaspur are located in the central part of the district while Doiwala block is located in the southern part of the study area.

(iii) Low Level of Livestock Development (below –0.27)

In 1991 only one block come under this low category i. e. Raipur block (-0.88) which is situated in the south central part of the district (Fig. 5.2(ii). This block shows lack of number of livestock, number of cattles as well as in number of poultry. This block is most developed as well as most populated.

Spatial Pattern of Livestock Development (2001)

(i) High level of Livestock Development (above 0.33)

The two blocks, Chakrata (0.94) and Kalsi (0.46) have attained the high grade of livestock development as in 1981 and 1991 Table 5.2(iii). Table shows that the composite z-score of livestock in these two blocks has incrased from 0.67 to 0.94 in Chakrata and 0.31 to 0.46 in Kalsi. Both the blocks are located in the northern part of the district Fig. 5.2(iii). In these blocks the contribution of livestock and cattles are more.

(ii) Medium Level of Livestock Development (+0.33 to -0.33)

Two blocks namely Vikas Nagar (-0.30) and. Sahaspur (0.19) come under the medium grade. In the last two decade the Vikas Naar and Sahaspur

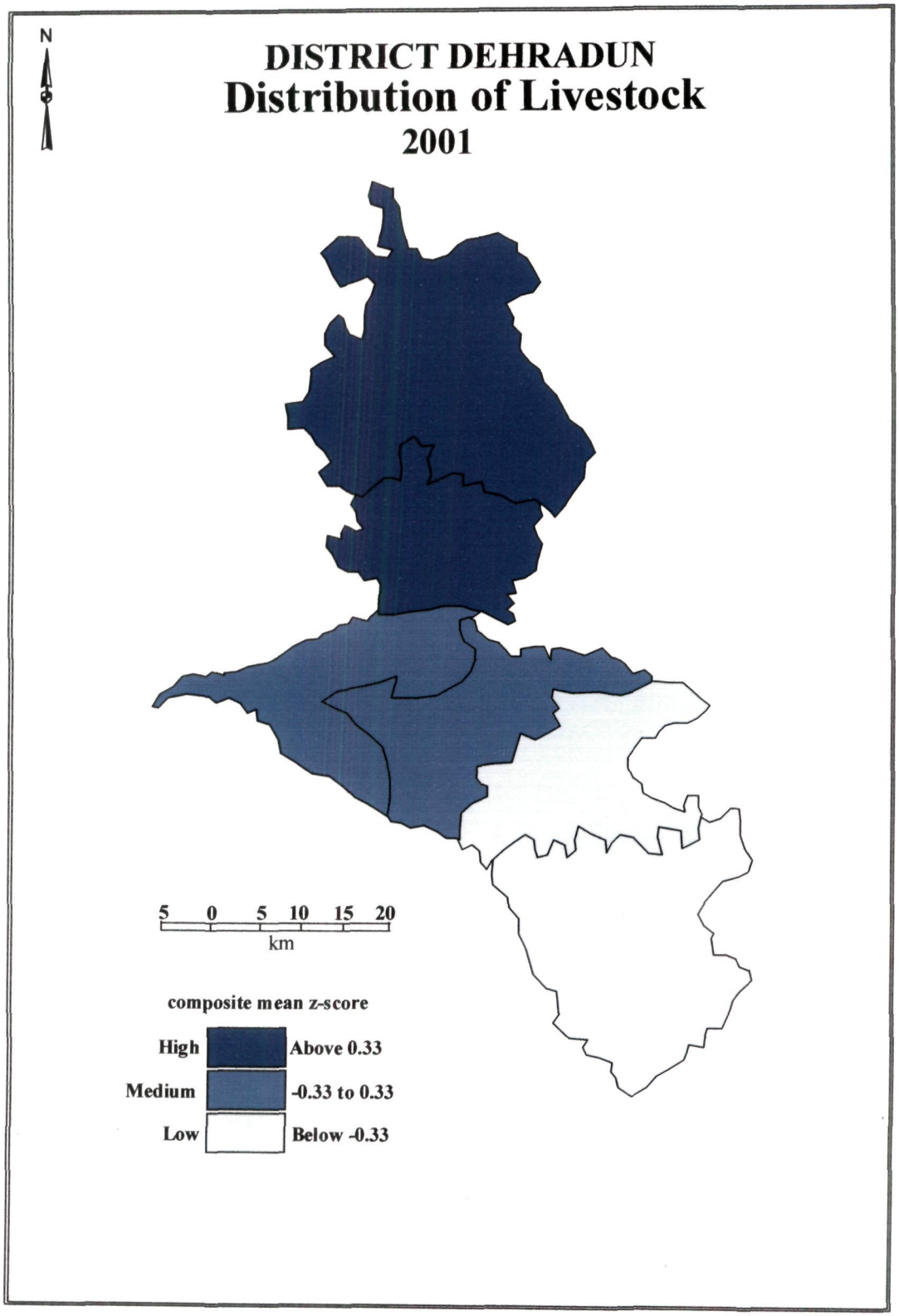

N
DISTRICT DEHRADUN
Distribution of Livestock
2001
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.33
Medium
-0.33 to 0.33
Low
Below -0.33

Fig. 5.2(iii)

block always come under the medium grade and these blocks are located in the west and central part of the district. In these blocks number of poultry shows a very strong position while the other variable shows negative z-score.

(iii) Low Level of Livestock Development (below –0.33)

In 2001 two blocks come under this low category, namely, Raipur (-0.92) and Doiwala (-0.34) as shown in Table 5.2(iii). Raipur and Doiwala are situated in the Southern part of the district Fig. 5.2(iii). Doiwala was under the medium grade in 1981 as well as in 1991 but in 2001 it came under the low grade. Whereas Raipur block remained always under the low grade in all the decades of 1981, 1991 and 2001 as shown in figs. 5.2(i), 5.2(ii) and 5.3(iii).

Chapter 6

Socio-Economic Environment

Chapter – 6

SOCIO-ECONOMIC ENVIRONMENT

Man lives and interacts with nature in a variety of ways. Strong amortization of man for advancement in civilization, science, technology and control of natural forces gives credit into atomic power and space travel but has degraded the environment. Fast industrialization with little care of adverse impact on environment has forced him to think seriously. Today man is living in a critical relationship with environment. He is running the world with overpopulation, fast industrialization, urbanization, deforestation and social and cultural changes. Some of these problems have attained alarming dimensions. The responsibility lies on human beings.

Today the social scientists study the aspects of social and natural environment with relationship between man and nature. Their study is in context of social and economic changes and not to Punch Bhutas in Puranic ideology consisting of Chiti (land), Jal (water), Pawak (energy) Gagan (sky) and Samera (air). It is a case of "social life in an environment bottle". Thus, this chapter with wider concept attempts to study the economic and social issues responsible for degradation of the environment (Murti, 19981).

The socio-economic aspects of environment reveal how the environment is being accepted or rejected socially and how economically greed is systematically destroying it (Mohan, 1988).

Albeit environmental influence on the raising of crops and rearing of animals is decisive, the socio-cultural constraints have to play a significant role in the agricultural prosperity of Dehradun District. The social constraints include population, land tenure, size of operational land holdings and land reforms while the economic background is formed of irrigation, electrification, financial institutions and means of transport and communication.

6.1 POPULATION

Man being by far the most important of a real attributes forms the focus of studying in each and every analytical frame of science and humanities (Singh, 1981 cited in Singh, 1986). As a matter of fact, man is the main factor and prime mover of all the developmental processes. Not with standing the excellence of all other situations, if there is qualitative degeneration in human beings, all other spheres of the society, polity and economy degenerate and decay. So, man being the pivot of activities on the earth is of core concern in each and every geographical discussion. As a matter of fact he becomes an inevitable point of reference from which elements are observed and inference is drawn (Finch and Trewartha, 1957).

The ensuring discussion on population will highlight the growth, distribution, density, sex-ratio, age-composition and migration of population in Dehradun district.

Population plays an important role in determining the nature of human settlements in terms of size and economy. The layout of the settlements and there vertical and horizontal growth are the direct outcome of the size of population, its pressure and density. Therefore, an attempt has been made here to discuss the demographic characteristics of the study area.

6.1(i) Population Growth

A perusal of the population figures of the study area indicates that since 1901 census there has been a steady population growth in the district, the only exception being the period of 1901-1921 when it registered a negative growth. This negative growth is attributed to the fact that during this period India suffered from a number of serious natural calamities, like the famine of 1897, which resulted in a reduction in birth rate. The population growth shows two discernible trends, a decreasing population

trend till 1921 and a continuous increase since 1921. During 1901-1911, the population increased by 15.3 per cent but in the next decade it decreased by 3.6 percent. The decade witnessed an increase in the death rate resulting in decline in population. Since 1921 the population has been increasing continuously, and so this year is known as great divide in Indian demography to denote between the decreasing and the increasing trend. The decade ending in 1931 exhibited a growth rate of 8.5 per cent, which increased to 15.6 per cent in 1941.

It is revealed from the computed statistics that the study area recorded a growth rate of 34.6 per cent during 1961-71 and 31.9 per cent during 1971-81. As a result of increased health care the mortality rate has gone down and the family planning measures have not been able to control the growth of population. During the last decade, 1991-2001, there is an increase in population by 25 per cent.

Table 6.1(i)

Dehradun District: Growth of Population

Census Year	Total Population		Rural Population		Urban Population	
	Number	Percentage	Number	Percentage	Number	Percentage
1901	1,77,465	0.00	1,37,999	0.00	39,466	0.00
1911	2,04,534	15.30	1,48,880	7.90	55,654	41.00
1921	2,11,887	3.60	1,45,567	-2.30	66,310	19.10
1931	2,29,850	8.50	1,65,458	13.70	64,392	-2.90
1941	2,65,786	15.60	1,72,057	4.00	93,729	45.60
1951	3,61,689	36.10	1,90,090	10.50	1,71,599	83.10
1961	4,29,014	18.60	2,31,179	21.60	1,97,835	15.30
1971	5,77,306	34.60	3,05,529	32.20	2,71,777	37.40
1981	7,61,668	31.90	3,89,527	27.50	3,72,141	37.00
1991	10,25,679	34.70	5,10,199	31.00	5,15,480	38.50
2001	12,82,143	25.00	6,03,401	18.30	6,78,742	31.67

Source : Census of India 2001, Dehradun, District Statistical Office.

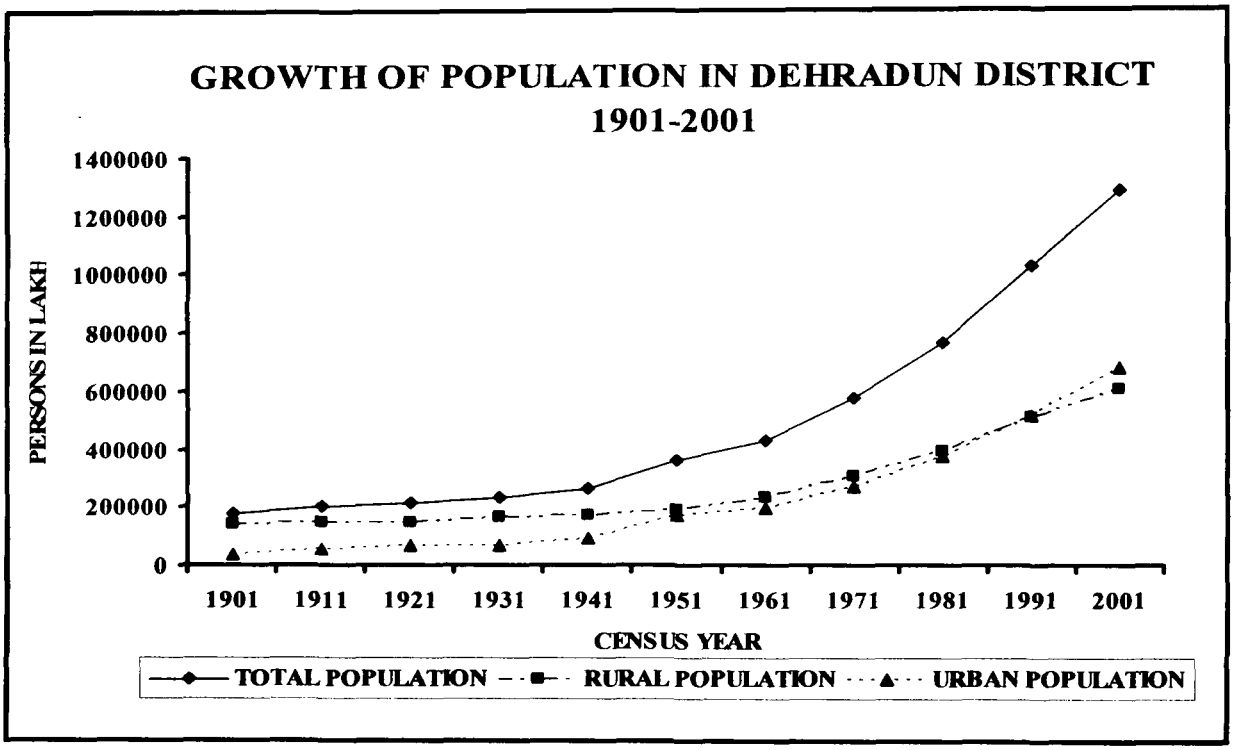

GROWTH OF POPULATION IN DEHRADUN DISTRICT
1901-2001
PERSONS IN LAKH
1400000
1200000
1000000
800000
600000
400000
200000
0
1901
1911
1921
1931
1941
1951
1961
1971
1981
1991
2001
CENSUS YEAR
TOTAL POPULATION
RURAL POPULATION
URBAN POPULATION

Fig. 6.1

6.1(ii) Arithmetic Density

The Arithmetic density is synonymous with the over all density and crude density of population. This will reveal simple man-land ratio. This means that here relationship between the total geographical area and the total population of the district will be ascertained. It is expressed as persons/km^2 or per square mile of the land.

Table 6.1(ii)

Dehradun District : Arithmetic Density of Population

Blocks	Area (km^2)	1981		1991		2001	
		Popu-lation	Density	Popu-lation	Density	Popu-lation	Density
Chakrata	415.03	45942	110.69	55590	133.94	63550	153.12
Kalsi	401.93	42620	106.04	51336	127.72	55117	137.13
Vikas Nagar	504.51	88659	17573	119155	236.18	146583	290.54
Sahaspur	697.06	95841	137.49	138483	198.67	155155	222.58
Raipur	605.73	368192	607.85	473248	781.28	615220	1015.67
Doiwala	463.74	120414	259.66	187867	405.11	246518	531.59
District	**3088.00**	**761668**	**246.65**	**1025679**	**332.15**	**1282143**	**415.20**

Source : Census of India 1981, 1991, 2001, Dehradun, District Statistical Office.

Table 6.1(ii) represents the arithmetic density of population for the census year 1981, 1991 and 2001. The arithmetic density accounts for 415.20 persons/km^2 for the district as a whole in 2001. The density shows remarkable area variations from 137.13 persons/km^2 in Kalsi block to as high as 1015.67 persons/km^2 in Raipur block. The latter however, contains the urban population of Dehradun town while the former is purely rural. Other blocks such as Chakrata, Vikas Nagar, Sahaspur and Doiwala are in the range of 150 to a little over 500 persons per km^2. It is evident that comparatively higher arithmetic density can be marked out in the southern part of the district.

An inspection of Table 6.1(ii) will further throw light on the temporal aspects of the arithmetic density of population in Dehradun District between 1981 and 2001. Taking the district as a whole, it can be said that the density of population in 1981 was 246.65 persons per km^2. It has become nearly twice (415.2) of the figure in 2001. Almost the same is the magnitude of increase in the density of other blocks as well except Chakrata and Kalsi blocks. The increase in Raipur and Doiwala block is more or less more than double of the density in 1981. Thus, it is amply clear that only over the last 30 years, the population density has almost been doubled in Dehradun district.

6.1(iii) Physiological Density

The physiological density of population reveals man land relationship rather more clearly in the areas where the pressure of population is acute and intense on the agricultural land. Here, the total population has been divided by the area of net cropped land. The dependence of population for livelihood being mainly on the arable land, it gives rather a more real picture regarding man-resource nexus.

Table 6.1(iii)

Dehradun District : Physiological Density of Population

Blocks	Population			Net sown Area (km^2)			Physiological Density		
	1981	1991	2001	1981	1991	2001	1981	1991	2001
Chakrata	45942	55590	63550	89.03	84.28	76.21	516.03	659.59	833.88
Kalsi	42620	51336	55117	72.17	65.66	59.38	590.55	781.84	928.21
Vikas Nagar	88659	119155	146583	104.86	84.69	97.92	845.49	1406.95	1496.97
Sahaspur	95841	138483	155155	107.82	97.67	110.44	888.89	1417.87	1404.88
Raipur	368192	473248	615220	71.14	80.66	83.96	5175.59	5867.19	7327.54
Doiwala	120414	187867	246518	107.72	97.06	98.76	1117.84	1935.57	2496.13
District	**761668**	**1025679**	**1282143**	**552.74**	**510.02**	**526.67**	**1377.98**	**2011.05**	**2434.43**

Source : Census of India 1981, 1991, 2001, Dehradun, District Statistical Office.

Table 6.1(iii) represents the physiological density of population. It is based on the census returns of 1980-81 and 1990-91 and 2000-2001. The average physiological density of population (2001) accounts for 2434.43 persons/km^2 of the net area sown. The regional variations are also evident from Table 6.1(iii). The following patterns of the variations are discernible:

- Raipur Block accounts for the highest physiological density of 7327 persons per km^2 of the net area sown. It may be attributed to the urban population of Dehradun town. This means that, where arithmetic density is higher due to the urban population, the physiological density will exceptionally swell it that very component.
- Vikas Nagar, Sahaspur and Doiwala blocks represent physiological density of the range between 1000-3000 persons per km^2 of the net area sown. The higher physiological density of population in these blocks is due to the expansion of urban centers. It has led to an increase in population and hence an increase in the physiological density of population. It can thus be established that physiological density of population will increase due to the following two reasons.

  When incidence of the N.A.S. is low due to the physical limitations;

  When the total population is increased due to existence of towns in the component concerned.

Table 6.1(iii) further shows changes in the physiological density of population occurring over the last three decades, during 1980-81, 1990-91 and 2000-2001. Evidently in majority of the components, the physiological density in 2001 has become more than double of the density during 1981.

The rapid population growth, the shrinking extent of net area sown due to the uncertain and unstable hydrographic conditions in Doiwala and Raipur blocks, the physiological density has swollen in these blocks. While in the remaining, the increase in physiological density during 1981 and 2001 is moderate. As for instance in Chakrata and Kalsi, the density figures of 2001

are less than double of the figures of 1981. The rapid growth of population here in these blocks is the main reason to be adduced to account for the increase in physiological density of population during 1981 and 2001.

6.1(iv) Per Capita Net Area Sown

As explained above, physiological density represents number of persons per unit of area of the net area sown. It fails to provide a vivid picture as to the area sown available, where is sufficient or deficient with regard to the maintenance of the people with a good wealth and vigour. As such, the concept of per capita availability of land is more meaningful than the concept of the physiological density of population (Alexander, 1963).

In the light of the above mentioned fact, here an attempt has been made to calculate per capita availability of the net area sown (Table 6.1(iv). In order to keep a person in good health and activity, a minimum of one hectare of the arable land is essential (Thirumalai, 1954). The limit has further been lowered to 0.40 hectare for the countries of the middle latitudes (Stamp, 1958; Verma, 1967; Mukharjee, 1938; Singh, 1970). It is evident from the present studies that here much less than 0.40 hectare (an acre) is available per person. It is lower by any of the two measures mentioned above.

Table 6.1(iv)

Dehradun District : Per Capita Net Area Sown

Blocks	Net sown Area (ha)			Total Population			Per Capita Net Area Sown		
	1981	1991	2001	1981	1991	2001	1981	1991	2001
Chakrata	8903	8428	7621	45942	55590	63550	0.19	0.15	0.12
Kalsi	7217	6566	5938	42620	51336	55117	0.17	0.13	0.11
Vikas Nagar	10486	8469	9792	88659	119155	146583	0.12	0.07	0.07
Sahaspur	10782	9767	11044	95841	138483	155155	0.11	0.07	0.07
Raipur	7114	8066	8396	368192	473248	615220	0.02	0.02	0.01
Doiwala	10772	9706	9876	120414	187867	246518	0.09	0.05	0.04
District	**55274**	**51002**	**52667**	**761668**	**1025679**	**1282143**	**0.07**	**0.05**	**0.04**

Source : Census of India 1981, 1991, 2001, Dehradun, District Statistical Office.

It is clear from the table 6.1(iv) that the availability of per capita net area sown is far below the limits given earlier. It is also clear that the per capita availability of the net area sown is gradually declining as it is recorded in the Table 6.1(iv) during 1981, 1991 and 2001. This trend is visible in each of the components of the study region. The decline can be assigned to the following reasons.

- Rapid increase in population,
- Shrinkage in the net area sown due to the expansion in area under homesteads, roads, irrigation, channels, railway lines, Govt. installations, institution etc.

6.1(v) Nutritional Density of Population

Nutritional density can be obtained on dividing the total cropped land during the agricultural calendar years coinciding with the year of census. The total cropped land is the area occupied by all the field crops raised during a certain agricultural calendar year. The nutritional density indicates relationship that exists between the density of population and the intensity of cropping.

Table 6.1(v)

Dehradun District : Nutritional Density of Population

Blocks	Total Rural Population			Total Cropped Land (km^2)			Nutritional Density (persons/km^2)		
	1981	1991	2001	1981	1991	2001	1981	1991	2001
Chakrata	40725	50920	60054	123.75	133.17	117.53	329.09	382.37	510.97
Kalsi	42620	51336	55117	106.79	117.02	103.47	399.10	290.00	532.68
Vikas Nagar	79658	89323	124854	192.05	149.31	167.73	414.78	598.24	744.37
Sahaspur	77608	104137	120402	177.47	135.30	148.95	437.30	769.67	808..34
Raipur	57647	109911	90381	108.91	107.30	101.25	529.31	1024.33	892.65
Doiwala	91269	104572	152593	191.00	138.55	141.94	477.85	754.76	1075.05
District	**389527**	**510199**	**603401**	**899.97**	**780.65**	**780.87**	**432.82**	**653.55**	**772.73**

Source : Census of India 1981, 1991, 2001, Dehradun, District Statistical Office.

Table 6.1(v) throws light on the nutritional density of population based on the census of 1981, 1991 and 2001. The nutritional density for the district as a whole was worked out to 432 persons per km^2 and 772 persons per km^2 in 1981 and 2001 respectively. It is evident that the nutritional density of population in Dehradun District has increased by leaps and bounds between 1981 and 2001. From an inspection of the Table 6.1(v) it is further evident that the nutritional density between 1981 and 2001 has increased in all the blocks of the district except Kalsi block. Sahaspur and Doiwala blocks show remarkable increase in the nutritional density of population during 1981 and 2001. In Sahaspur block the density has increased from 437 (1981) to 808 (2001) and in Doiwala from 477 (1981) to 1075 (2001).

Table 6.1(v) further reveals that the extent of the total cropped land has suffered from fluctuations from year to year, mostly because of the land slides, floods etc, while the growth of population is a continuous demographic event with only minor decadal variation. As a result, the increase in nutritional density is indispensable in the district under review.

6.1(vi) Caloric Density

In semi-subsistence economy as in that of Dehradun District, the food-grains such as paddy, wheat, maize, barley and pulses are of the paramount importance, claiming 60 to 80 per cent of the total cropped land. As such it is clear that there is a very close relationship between the density of population and the areal extent of the foodgrains. Table 6.1(vi) given below shows the relationship between rural population and the areal coverage under food grains.

The caloric density in the district as a whole is 1067 persons/km^2 (2001). The increase in caloric density is a common phenomenon everywhere in Dehradun District.

Table 6.1(vi)

Dehrdun District : Caloric Density of Population

Blocks	Total Rural Population			Total Area under Foodgrains (km^2)			Caloric Density (persons/km^2)		
	1981	1991	2001	1981	1991	2001	1981	1991	2001
Chakrata	40725	50920	60054	106.19	82.75	82.75	383.51	615.35	725.73
Kalsi	42620	51336	55117	96.83	88.06	88.06	440.15	582.96	625.90
Vikas Nagar	79658	89323	124854	143.92	120.65	120.65	553.49	740.35	1034.84
Sahaspur	77608	104137	120402	132.50	112.95	112.95	585.72	921.97	1065.98
Raipur	57647	109911	90381	81.92	66.52	66.52	703.69	1652.30	1358.70
Doiwala	91269	104572	152593	129.63	94.08	94.08	704.07	1111.52	1621.95
District	**389527**	**510199**	**603401**	**690.99**	**565.01**	**565.01**	**563.72**	**902.99**	**1067.95**

Source : Census of India 1981, 1991, 2001, Dehradun, District Statistical Office.

It is a common conception that the period during and after Green Revolution has witnessed an exceptional increase in the area of foodgrains. Hence, it may be observed that the growth in population expansion in the area of food grains and caloric intake of people has increased simultaneously (Sharma, 1999).

Table 6.1(vii)

Composite Population Density on the basis of composite mean z-score

Blocks		Arithematic density of population	Physiological density	Per capita net sown area	Nutritional density of population	Caloric density of population	Composite index
Chakrata	1981	-0.69	-0.61	1.40	-1.63	-1.47	-0.60
	1991	-0.79	-0.76	1.75	-1.02	-0.87	-0.34
	2001	-0.77	-0.69	1.25	-1.26	-1.01	-0.49
Kalsi	1981	-0.72	-0.57	1.00	-0.51	-1.01	-0.36
	1991	-0.81	-0.69	1.25	-1.39	-0.96	-0.52
	2001	-0.83	-0.65	1.00	-1.15	-1.30	-0.58
Vikas Nagar	1981	-0.33	-0.41	0	-0.26	-0.07	-0.21
	1991	-0.34	-0.34	-0.25	-0.15	-0.54	-0.32
	2001	-0.33	-0.41	0	-0.08	-0.11	-0.18
Sahaspur	1981	-0.54	-0.38	-0.20	0.09	0.19	-0.17
	1991	-0.50	-0.33	-0.25	0.54	-0.04	-0.12
	2001	-0.55	-0.45	0	0.24	-0.02	-0.05
Raipur	1981	2.14	2.22	-2.00	1.56	1.17	1.02
	1991	2.04	2.17	-1.5	1.56	1.95	1.24
	2001	2.02	2.17	-1.5	0.67	0.83	0.84
Doiwala	1981	0.15	-0.24	-0.60	0.74	1.18	0.25
	1991	0.39	-0.04	-0.75	0.48	0.47	0.11
	2001	0.45	0.04	-0.75	1.59	1.60	0.58

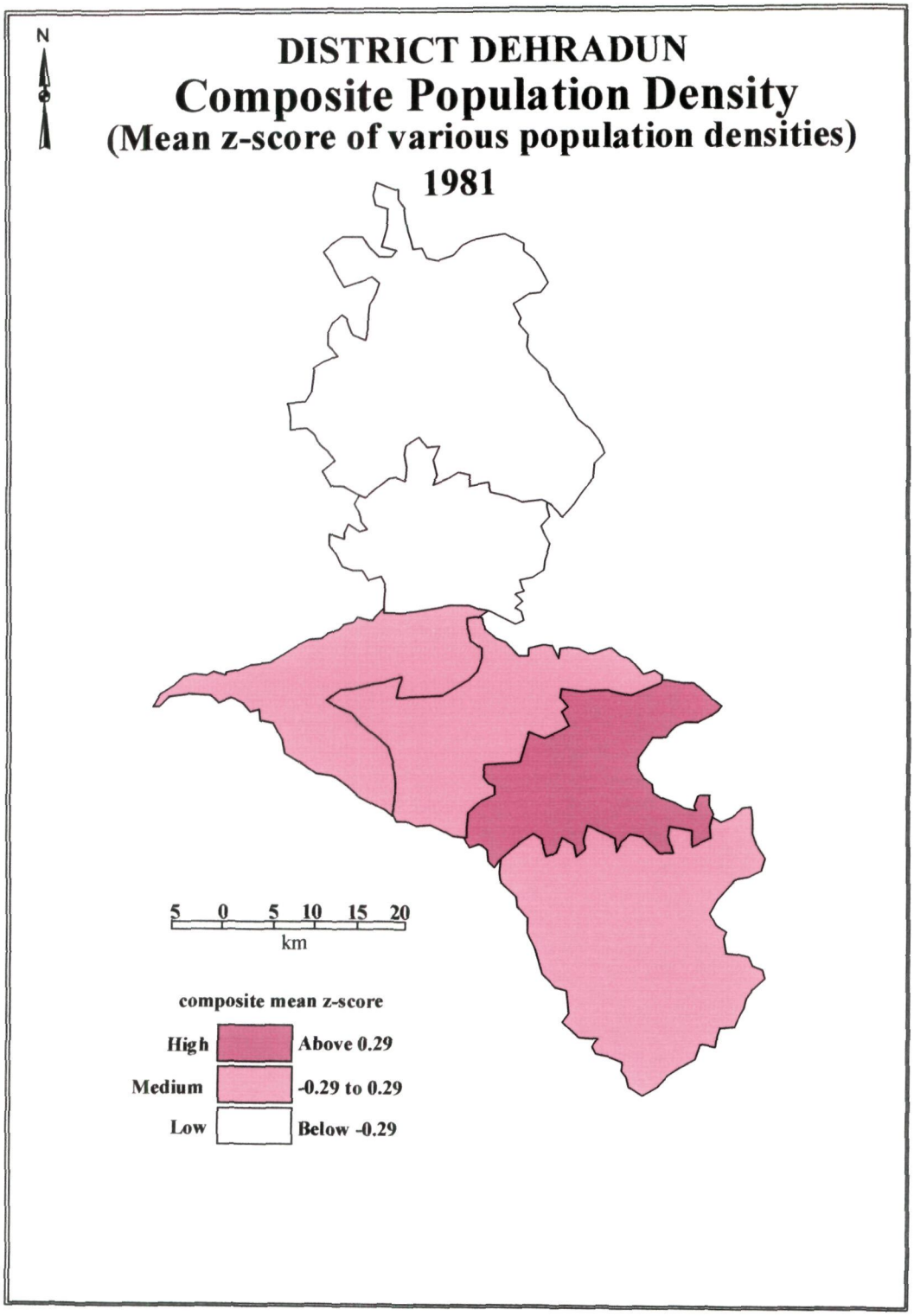

N
DISTRICT DEHRADUN
Composite Population Density
(Mean z-score of various population densities)
1981
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.29
Medium
-0.29 to 0.29
Low
Below -0.29

Fig. 6.1(i)

Spatial Pattern of Population Densities in Dehradun District (1981)

(i) High Composite Population Density (above 0.29)

The High category consists of only one block i.e Raipur block (1.02). This block is located in the South Central part of the district (fig 6.1(i). This block records high composite population density due to a variety of reasons. This block enjoys very high arithmetic density, physiological density, nutritional density and caloric density of the population.

(ii) Medium Composite Population Density (+0.29 to –0.29)

Three blocks come under this medium category of composite population density; these are Vikas Nagar (-0.21), Sahaspur (-0.17) and Doiwala (0.25). Two blocks, Vikas Nagar and Sahaspur are located in the center in the district but Doiwala block is situated on the southern part of the study area Vikas Nagar and Sahaspur shows negative composite mean z-score but Doiwala block shows positive composite mean z-score. And in Sahaspur block, nutritional density and caloric density have positive z-score and other indicators like arithmetic density, physiological density and per capita net sown area have negative z-score as shown in Table 6.1(vii).

(iii) Low Composite Population Density (below -0.29)

This category consist of two blocks viz, Chakrata (-0.60) and Kalsi (-0.36). These two blocks are located in the upper part or in northern portion of the district shown in fig. 6.1(i). All the indicators in these two blocks except per capita net sown area have high negative z-score. Per capita net sown area has positive z-score because these two blocks are mainly rural areas and size of population is small and net sown area is large. These two blocks are the most backward blocks of the district.

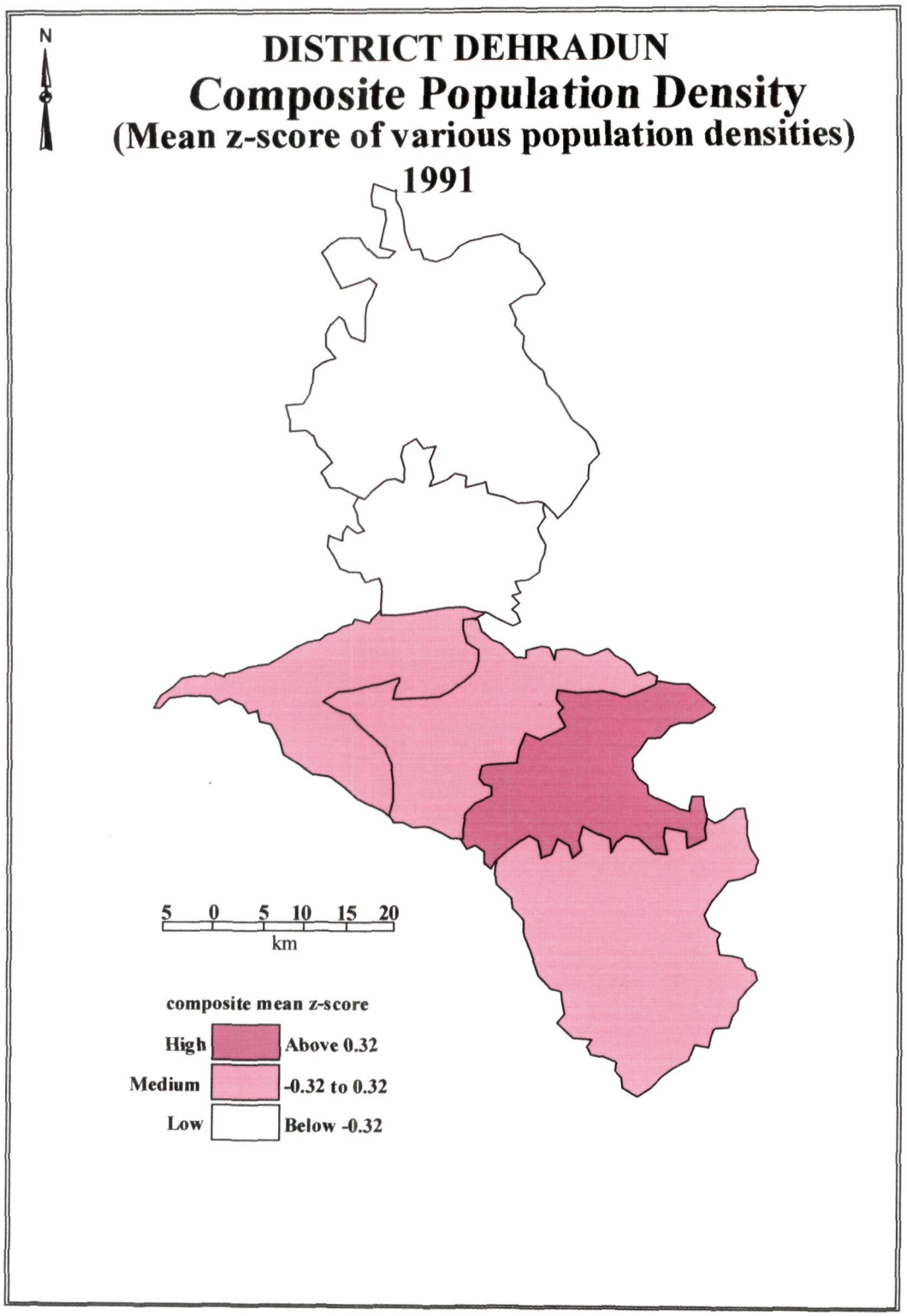

N
DISTRICT DEHRADUN
Composite Population Density
(Mean z-score of various population densities)
1991
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.32
Medium
-0.32 to 0.32
Low
Below -0.32

Fig. 6.1(ii)

Spatial Pattern of Population Densities in Dehradun District (1991)

(i) High Composite Population Density (above +0.32)

One block i.e. Raipur block (1.24) come under this high grade as in 1981. Only one indicator in Raipur block i.e. per capita net sown area has negative z-score because in this block the population size is big while the net sown area is small, otherwise all the other indicators have high positive z-score as shown in Table 6.1(vii).

(ii) Medium Composite Population Density (+0.32 to -0.32)

This medium category consists of three blocks viz. Vikas Nagar (-0.32), Sahaspur (-0.12) and Doiwala (0.11). Vikas nagar lies in the estern part, while Sahaspur is located in the center of the district and Doiwala block lies in the southern part of the district (fig 6.1(ii)). In Doiwala block three indicators out of five have positive z-score, two indicators like physiological density and per capita net sown area have negative z-score. In Sahaspur block one indicator i.e. nutritional density of population has positive z-score other four indicators have negative z-score (Table 6.1(vii)). In Vikas Nagar block all the five indicators show negative z-score.

(iii) Low Composite Population Density (below –0.32)

In 1991 two blocks Chakrata (-0.34) and Kalsi (-0.52) come under the low category of composite population density. These two blocks are located in the northern part of the district, Fig. 6.1(ii).

Spatial Pattern of Population Densities in Dehradun District (2001)

(i) High Composite Population Density (above +0.28)

This category consist of two blocks viz Raipur (0.84) and Doiwala (0.58). These two blocks are situated in the Southern part of the district (Fig. 6.1 (iii). In the previous decades of 1981 and 1991 Doiwala block was under the medium category but in 2001 it came under high category.

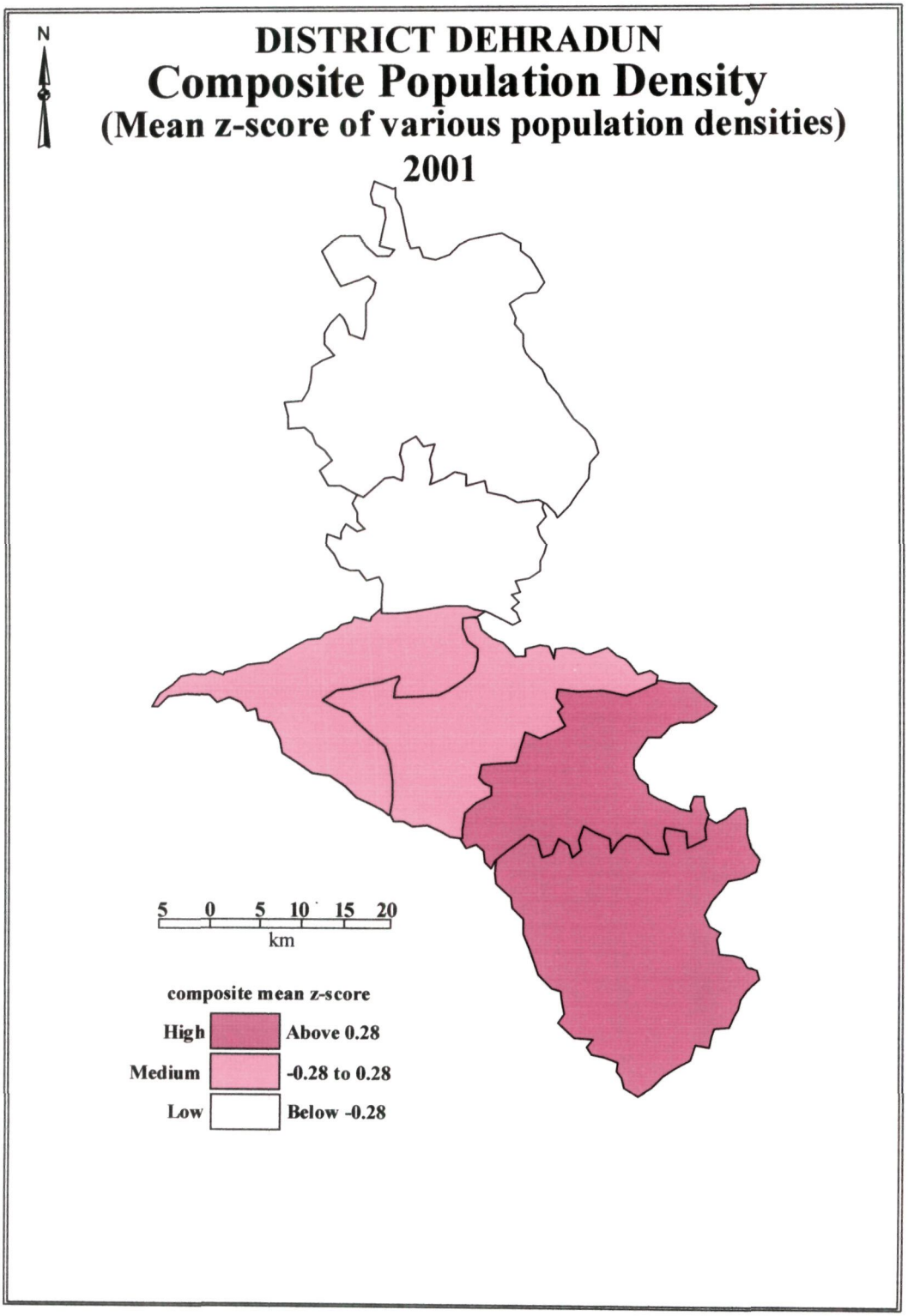

N
DISTRICT DEHRADUN
Composite Population Density
(Mean z-score of various population densities)
2001
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.28
Medium
-0.28 to 0.28
Low
Below -0.28

Fig. 6.1(iii)

In both the blocks only one indicator i.e. per capita net sown area shows negative z-score otherwise all the other indicators shows high and very high positive z-scores. In Doiwala block arithmetic density of population, physiological density, nutritional density, caloric density etc. are increasing in 2001 from 1981 and 1991 (Table 6.1(vii)).

(ii) Medium Composite Population Density (+0.28 to –0.28)

In 2001 this medium category of composite population density consists of two blocks namely Vikas Nagar (-0.18) and Sahaspur (-0.15). Both are located in the center of the district (fig.6.1(iii). In 1981, 1991 and 2001, both the blocks were remain always in the medium category. In Sahaspur block only nutritional density has positive z-score while in Vikas Nagar block all the indicators have negative z-scores (Table 6.1(vii)).

(iii) Low Composite Population Density (below –0.28)

Two blocks consist of low category viz Chakrata (-0.49) and Kalsi (-0.58). Both are located on the northern portion of the district. In the decades of 1981, 1991 these two blocks were under the low gradient still in 2001 they are in the low category. These two blocks are basically undeveloped and rural areas.

6.2 URBANISATION

Urbanisation, means the proportion of total population concentrated in urban settlements. Urbanisation is an important aspect of the process of economic and social change and it is both a consequence and causal factor in the level of development. Sovani (1956) has pointed out that, urbanisation is the process by which villages turn into towns and towns develop into cities.

Bose (1956) has argued that, urbanisation in demographic sense, is an increase in the proportion of urban population (U) to total population (T) over a period of time. As long as U/T increases, there is urbanization.

Curie (1966) supports the thesis that urbanization is crucial for accelerating the nation's economic development. The level of urbanization in a region may be a meaningful indicator of economic development. Urban way of life is assumed to be synonymous of the desired quality of life as it enhances the per capita productivity and employment opportunity as well as ensures the basic amenities of life (Singh and Singh, 1981).

The concept of development may be taken to imply as improvement in the material and cultural well being of the people in a region. The development of a region can be identified with the increase in the employment opportunities, availability of infrastructural facilities, amenities and services, proper distribution of resources, increased production, investment and consumption and so on. Thus the development refers to an improvement of all the sectors of economy and social and cultural pursuits (Shafiqullah, 1997).

Urbanisation in a strict demographic sense is the percentage increase of urban population to total population (Davis and Hertz 1957). Customarily the degree of urbanization of any place or any nation is defined as the proportion of urban population above a specified minimum population size residing in an urban area for a particular point of time. Despite various controversies over the exact definition of urban in terms of minimum population size, a general consensus has developed according to which the measure of level of urbanization is the percentage of urban to total population (Parveen, 2002)

Level of Urbanization in Dehradun District

Dehradun District has a total urban population of 3,72,141, 515480 and 678742 in 1981, 1991 and 2001 respectively. The district is divided into six development blocks and five blocks out of six have urban population because these five blocks have urban centers of various sizes

and population except Kalsi block. Kalsi block is totally a rural area. No urban centre lies in this block. So Kalsi block is not incorporated in the study of urbanization. About 52.9 per cent population out of the total population is urban (2001 census). Raipur block of the district is most congested, urbanized and developed because major urban centers of the district are located in this block while Chakrata block is the least urbanized and developed because only one urban center is situated in this block. The famous tourist spot i.e. Mussorrie Hills (Queen of Hills) is found in the Sahaspur block of the Dehradun district. The smallest urban centre is Landour Cantt (Sahaspur block) with a population size of only 3254 in 2001, and the largest one is Dehradun city (Raipur block) with 4,26,674 persons in 2001. While Dehradun cantt is highly congested with 76678 persons/km^2 while Mussorrie has only 403 persons/km^2 urban density. Dehradun district shows an increase in the percentage of urban population of 4.08 percent from 1981 to 2001 in terms of total population while in terms of urban population to rural population it recorded an increase of 16.95 percent. Urban sex ratio and urban literacy rates also recorded an increase as shown in Table 6.2(i).

Table 6.2(i)

Level of Urbanisation in Dehradun District

Blocks		Percentage of urban population to the total population	Percentage of urban Pop. to the Rural pop.	Number of Urban centers/100 Sq.km.	Urban sex Ratio	Decadal variation growth of urban pop.	Urban literacy Rate
Chakrata	1981	11.35	12.81	0.24	271	-14.50	67.9
	1991	8.40	9.17	0.24	319	-10.50	87.2
	2001	5.50	5.82	0.24	616	-25.14	85.7
Kalsi	1981	-	-	-	-	-	-
	1991	-	-	-	-	-	
	2001	-	-	-	-	-	-
Vikas Nagar	1981	10.15	11.29	0.59	845	27.4	62.7
	1991	25.04	33.39	0.59	867	231.4	76.8
	2001	14.82	17.40	0.39	899	-27.16	83.5
Sahaspur	1981	19.02	23.49	0.43	654	-24.5	66.8
	1991	24.80	32.98	0.43	696	88.4	78.7
	2001	22.39	28.86	0.29	788	1.19	87.7
Raipur	1981	84.34	538.70	0.83	804	43.2	69.6
	1991	76.77	330.57	0.83	845	16.9	83.7
	2001	85.31	580.69	0.66	873	44.45	88.5
Doiwala	1981	24.20	31.93	1.08	762	65.2	66.9
	1991	44.34	79.65	1.08	825	182.7	78.9
	2001	38.10	61.55	0.43	840	12.76	85.6
District	1981	48.86	95.54	0.55	783	36.9	66.8
	1991	50.26	101.03	0.55	826	38.5	81.1
	2001	52.94	112.49	0.36	863	31.67	86.2

Source : Census of India 1981, 1991, 2001, Dehradun, District Statistical Office.

Table 6.2(ii)

Level of urbanization on the basis of composite mean z-score

Blocks		Percentage of urban population to the total population	Percentage of urban Pop. to the Rural pop.	Number of Urban centers/100 Sq.km.	Urban sex Ratio	Decadal variation growth of urban pop.	Urban literacy Rate	Composite index
Chakrata	1981	-0.66	-0.53	-1.14	-0.85	-0.99	0.49	-0.61
	1991	-1.17	-0.74	-1.34	-1.91	-1.21	1.61	-0.79
	2001	-0.98	-0.60	-1.34	-1.86	-0.99	-0.28	-1.01
Kalsi	1981	-	-	-	-	-	-	-
	1991	-	-	-	-	-	-	-
	2001	-	-	-	-	-	-	-
Vikas Nagar	1981	-0.71	-0.54	-0.07	1.29	0.23	-1.79	-0.26
	1991	-0.46	-0.54	-0.14	0.76	1.39	-1.11	-0.02
	2001	-0.65	-0.55	-0.14	0.95	-1.07	-1.53	-0.49
Sahaspur	1981	-0.39	-0.48	-0.78	0.58	-1.29	-0.01	-0.39
	1991	-0.47	-0.54	-0.69	-0.07	-0.14	-0.62	-0.42
	2001	-0.38	-0.49	-0.69	-0.15	-0.001	0.85	-0.14
Raipur	1981	1.96	1.99	1.86	1.14	0.69	1.24	1.48
	1991	1.75	1.96	0.69	0.66	-0.91	0.69	0.81
	2001	1.85	1.99	0.69	0.69	1.63	1.31	1.36
Doiwala	1981	-0.20	-0.44	0.21	0.98	1.34	0.05	0.32
	1991	0.36	-0.15	1.55	0.56	0.87	-0.56	0.44
	2001	0.17	-0.35	1.55	0.36	0.44	-0.34	0.31

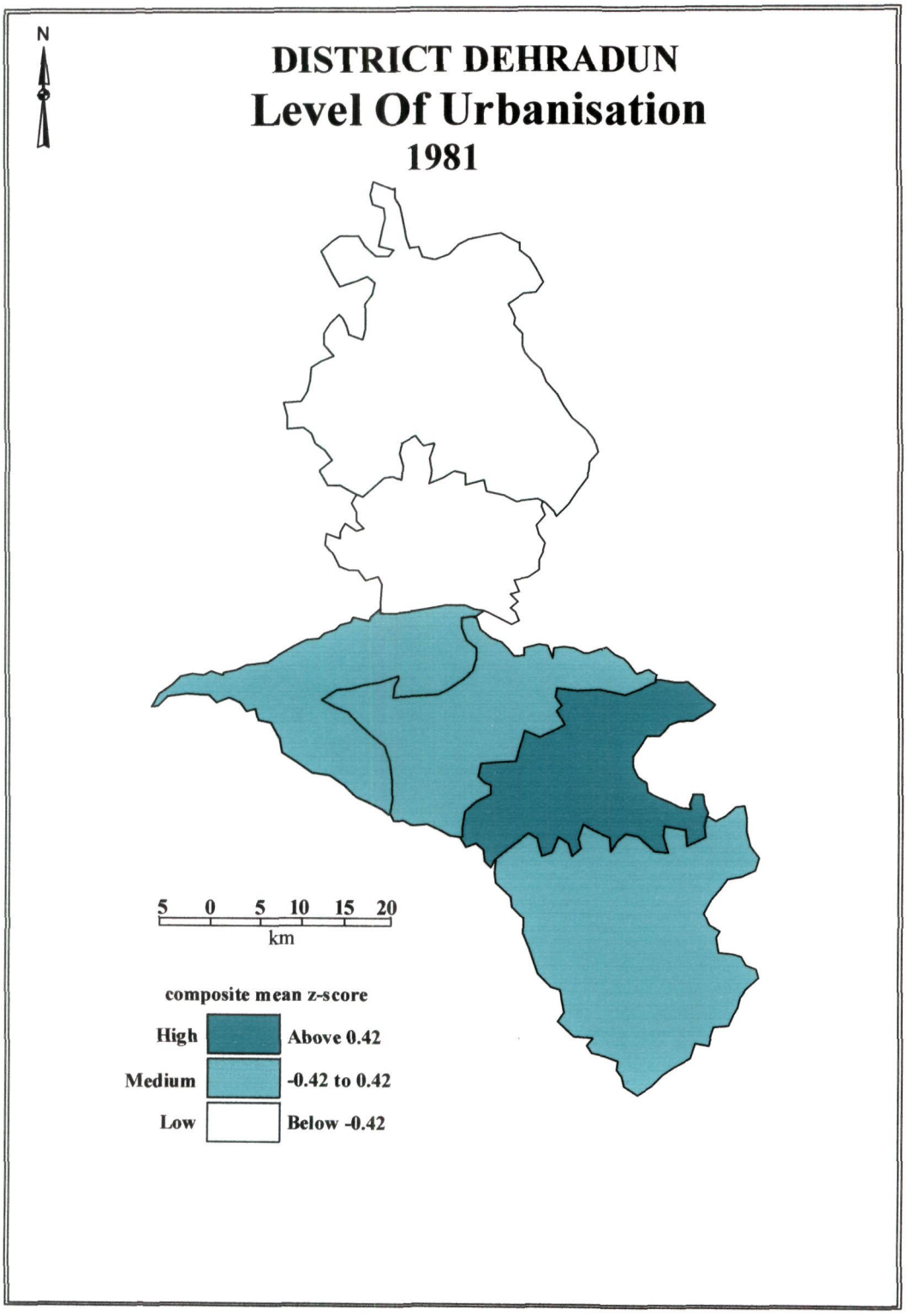

N
DISTRICT DEHRADUN
Level Of Urbanisation
1981
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.42
Medium
-0.42 to 0.42
Low
Below -0.42

Fig. 6.2(i)

Spatial Pattern of Urbanization in Dehradun District (1981)

(i) High Level of Urbanization (above +0.42)

The first category in which the composite mean z-score is above +0.42 indicates a relatively high level of urbanisation. Only one block fall in this category i.e. Raipur block (1.48). This block is located in the central part of the district fig 6.2(i). Raipur block shows a very high level of urbanization because it the most populated and developed block of the region.

(ii) Medium Level of Urbanization (+0.42 to –0.42)

The second group in which the composite score varied from +0.42 to –0.42 had a medium level of urbanization and three blocks namely, Vikas Nagar (-0.26), Sahaspur (-0.39) and Doiwala (0.32) fall in this grade. Vikas Nagar block is located on the western side while Sahaspur is located in the center and Doiwala is lie in the southern part of the district fig 6.2(i). Three urban centers namely Dak Pathar, Herbertpur and Vikas Nagar M.B. are located in Vikas Nagar block, while three urban centers are found in the Sahaspur block these are Mussoorrie, FRI and Landaur Cantt. Mussoorrie is a famous tourist spot.

(iii) Low Level of Urbanization (below –0.42)

The third category in which the composite score is below –0.42 shows a relatively low level of urbanization in the district. Only one block fall in this category. It is Chakrata (-0.61) (Table 6.2(ii). Chakrata is located on the upper most part of the district. Chakrata block have only one urban centre i.e. Chakrata Cantt.

Spatial Pattern of Urbanization in Dehradun District (1991)

(i) High Level of Urbanization (above + 0.32)

This category includes two block of Dehradun district viz Raipur (0.81) and Diowala (0.44) as shown in Table 6.2(ii). Table indicates that the urbanization level in Raipur block (in 1991) has decreased from 1981 and in

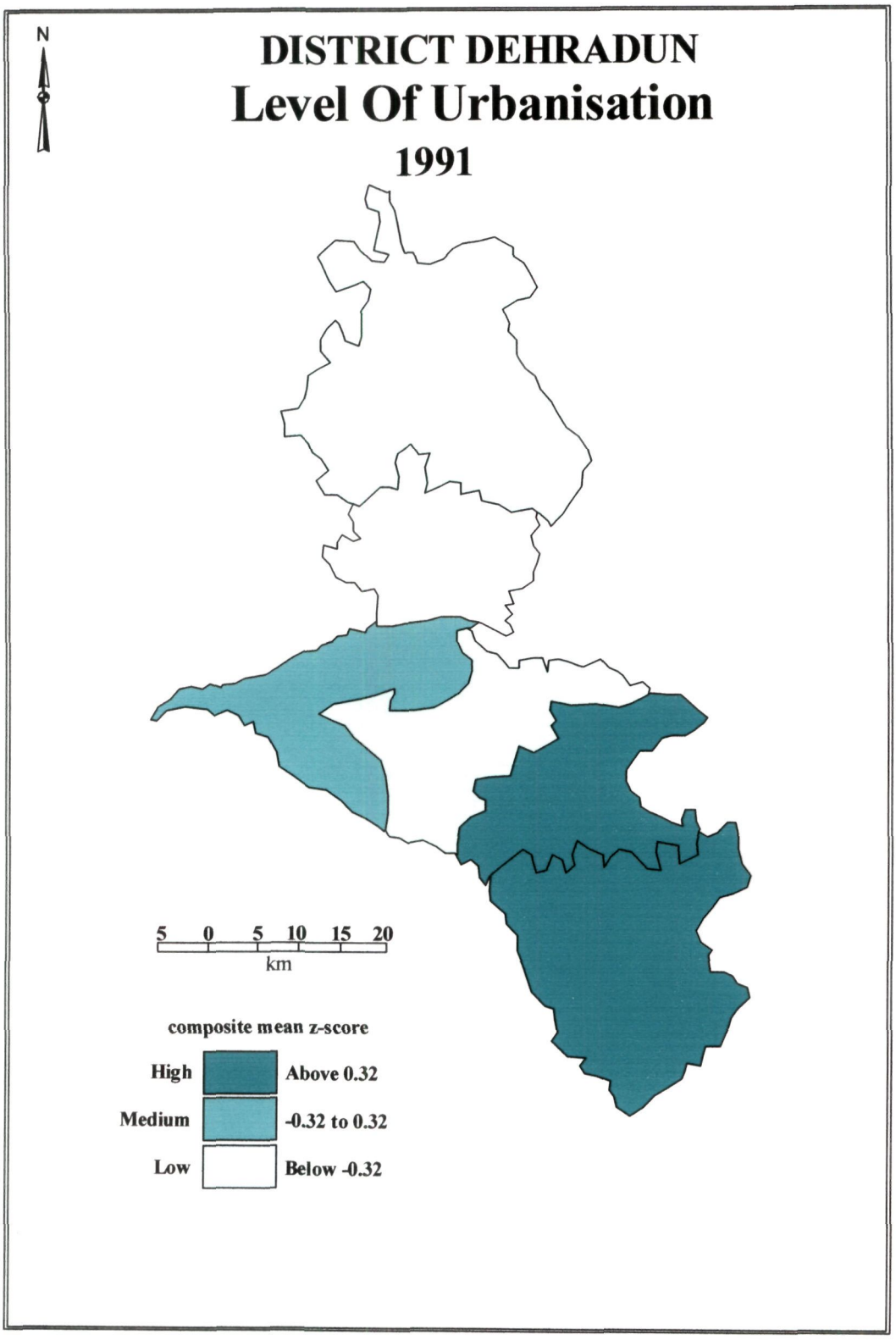

N
DISTRICT DEHRADUN
Level Of Urbanisation
1991
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.32
Medium
-0.32 to 0.32
Low
Below -0.32

Fig. 6.2(ii)

Doiwala block the urbanization level has witnessed an increase in comparison to 1981 but both the blocks are under the high grade of composite mean z-score. Both the blocks are located in the southern part of the study region. These blocks enjoy more urban population, number of urban centers, high urban sex ratio and high urban literacy rate.

(ii) Medium Level of Urbanization (+0.32 to –0.32)

In 1991 one block i.e. Vikas Nagar comes under this medium category. Table 6.2(ii), shows that there is an increase in the level of urbanization in comparison to 1981, but it is still in the medium grade. This block shows an increase in decadal variation growth in urban population. This block is situated on the western part of the Dehradun district (fig. 6.2(ii)).

(iii) Low Level of Urbanization (below –0.32)

Chakrata (-0.79) and Sahaspur (-0.42) fall in this low grade. Previously in 1981 only Chakrata block was under the low grade while Sahaspur block was under the medium grade of urbanization. Chakrata is located on the north of the district while Sahaspur is situated in the Centre of the district (fig. 6.2(ii). In Both the blocks the composite mean z-score of urbanization decreased from 1981, Table 6.2(ii).

Spatial Pattern of Urbanization in Dehradun District (2001)

(i) High level of Urbanization (above + 0.44)

As Table 6.2(ii) indicates that one block i.e. Raipur (1.36) was under the high category. It is located in the south central part of the district (Fig. 6.2(iii)). This block is the most urbanized and developed blocks of the district in 1981, 1991 and 2001. Table 6.2(ii) shows that there is an increase in the percentage of urban population, urban sex ratio and in urban literacy rate in Raipur block in 2001.

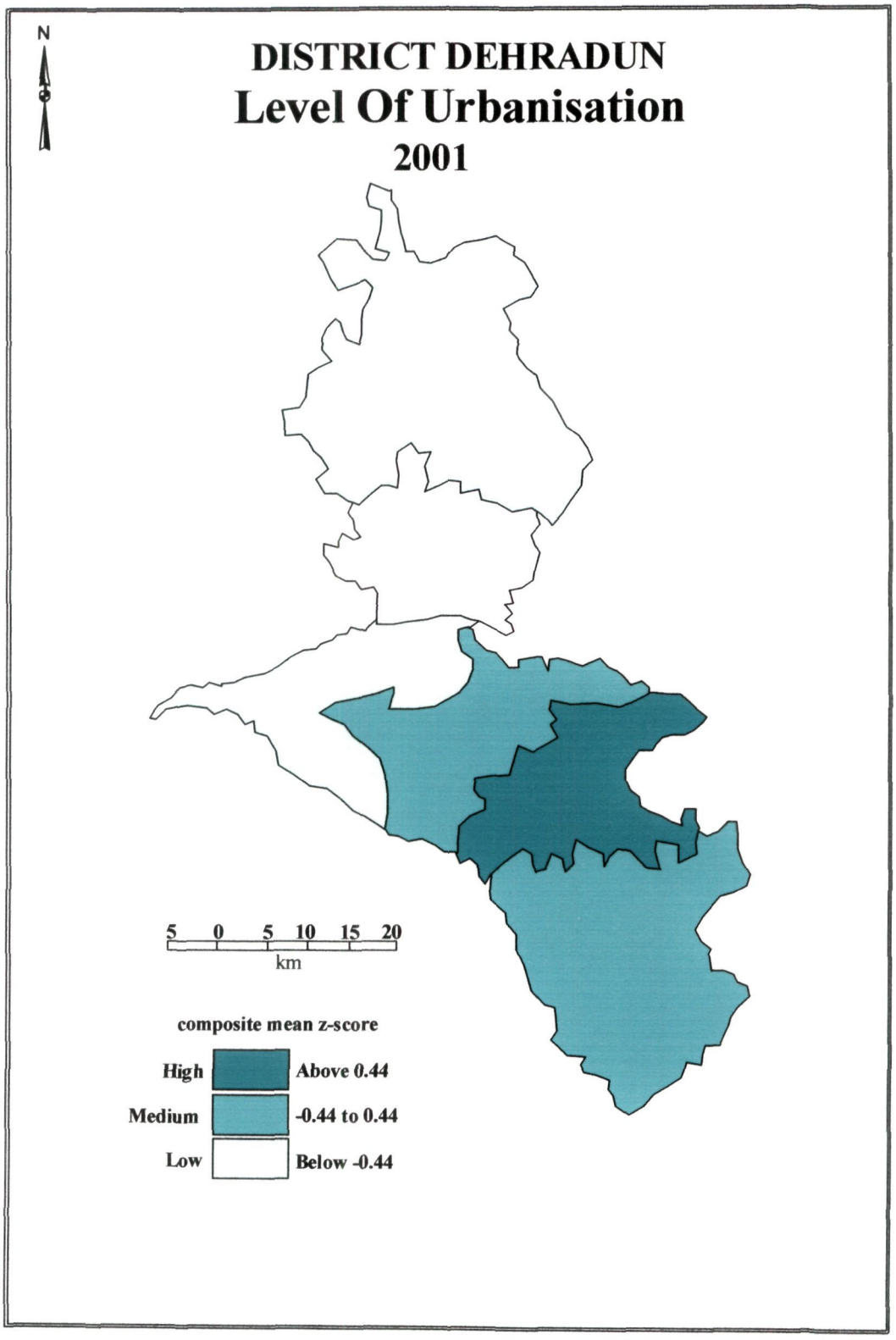

N
DISTRICT DEHRADUN
Level Of Urbanisation
2001
5 0 5 10 15 20
km
composite mean z-score
High
Above 0.44
Medium
-0.44 to 0.44
Low
Below -0.44

Fig. 6.2(iii)

(ii) Medium Level of Urbanization (+0.44 to -0.44)

Sahaspur block (-0.14) and Doiwala (0.31) was under the medium grade. In 1981 Sahaspur block and Doiwala block as under the medium category but in 1991 Sahaspur block went to the low grade and Doiwala block went to the high grade but again in 2001 both these blocks come under the medium level of urbanization. Sahaspur block shows a remarkable change in urban literacy rate in this decade. Table 6.2(ii) also indicates a little increase in the percentage of urban population. Sahaspur block is located in the center of the district and a very popular tourist spot Mussorrie lie in this block. Doiwala is located in the southern most part of the district.

(iii) Low level of Urbanization (below –0.44)

Again two blocks fall in this low category viz Chakrata (-1.01) and Vikas Nagar (-0.49) Table 6.2(ii). In 1981 and 1991 Vikas Nagar was under the medium grade but in 2001 it shows a decrease in the percentage of urban population, and in urban literacy rate that's why it falls in the low grade. While Chakrata block is still in low grade as in 1981 and 1991. Chakrata is located in the northern part of the district while Vikas Nagar block is situated on the western part of the district. Fig. 6.2(iii).

6.3 TOURISM

Tourism is growing very fast and has acquired a status of the foremost global industry. According to World Tourism Organization about 595 million people moved as Tourists in the world in 1996 considering it's importance and financial benefits of many countries of the world that are engaged in promoting tourism (Siddique,1998). Many of them depend on this sector especially from the developing world to correct their adverse balance of international trade, to create job opportunities and to reduce regional imbalances. While it is true that economic effects have caused some adverse social ecological consequences. This is the reason why the concept of sustainable tourism has emerged so boldly in recent years, especially in

respect of ecologically, sensitive environments. Because of aggressive tourism, mountain environments gifted with spectacular ecosystems, are losing their beauty. This problem is posing a threat to the fragile environments. Recent trends have led to the development of the concept of "GREEN TOURISM" or 'ECOLOGICAL TOURISM" Green tourism is the only hope in the mountaineous areas.

The Brundtland Report (1987) following the World commission on Environment and Development, further developed and reinforced the ideas of sustainable development. Actually four basic principles are seen to be crucial to the concept of sustainability;

1) the idea of holistic and strategic planning

2) the importance of preserving essential ecological processes;

3) the need to protect bio-cultural diversity;

4) to develop in such a way that productivity can be sustained over the long term.

Sustainable tourism is a positive approach intended to reduce the tension and friction created by the complex interactions between the tourism industry, visitors, the environment and the local communities. It is an approach which involves working for the long term viability and quality of both natural and human resources.

Tourism as an industry generates a number of economic and non-economic benefits, but it has also some adverse repercussions. The movement of people even for short duration as tourists from one place to another is responsible for impacting economic, socio-cultural and ecological set up of any locality.

Tourism has not only entered metropolitan town, historical monuments, sea-beaches and summer resorts but also entered into the sensitive Himalayan eco-systems where environment is most vulnerable.

This unplanned and unbridled intrusion of tourism has adverse impacts on the physical environment, regional development and economy of the region. Findings reveal that degradation of physical environment, acculturation and social dissolution, demonstration, commercialization of traditions, upsetting the regard for religious practices, destruction of flora and fauna, garbage traits, withdrawal of labour from agriculture, pollution and promotion of a 'throw away mentality' are among the scars that can be seen. Tourist development takes many forms, and these forms must blend with the milieu. It is perplexing problem of marketing naturally or historically given resources of actual potential. To achieve this, balance planners should know what development potential and development carrying capacity does the region/area possess from economic, ecological, political and cultural point of view (Singh, 1986).

In the absence of these facts mountain tourism is in dialectical tension between economy and ecology; autonomy and development (Brugger et. al., 1984). To achieve sustainability of tourist development in the Himalayan areas the impacts have to be considered very seriously. These impacts can be ecological, socio-cultural and related to economy. It is very difficult to classify these impacts in quantitative terms as many of them defy measurements.

The recreation resources are made up of different residence having varied degree of tolerance, since tourism in the Himalaya is made up of natural assets, understanding of the phenomenon landscape – its diagnosis, analysis and dynamics is very important. Infact, landscape is capital in Himalayan tourism and of the capital is in danger, there are meager chances of its survival (Krippendrof, 1983), Landscape, a planning medium in accord with nature, should be thoroughly studied to achieve a balance between the natural potential and the demand of the society.

a. Impact on Physical Landscape:

The core substance of tourism industry is the people – people's industry, made up of "guests and hosts". The host must know his guest in some details, and the guest should also know who would be his host. In the absence of these answers, tourism can be a disaster, both to the 'land' and 'the people'. So whenever tourism impact on physical environment or tourist ecology is discussed the question of threshold arises. Threshold is effective saturation level of resources, and negative effects began to operate as soon as threshold is crossed. It was observed that seasonality is a crucial factor, in the concept of saturation for no tourist areas have reached saturation throughout the year and stress mostly occurs for short peak period (W.TO: 1983). The climatic resorts setup by the Britishers in the middle Himalaya, in the case of Nainital and Mussoorie are experiencing mass tourism. The study of Mussoorie shows that it has long crossed their threshold and has shown stress capacity.

Mussoorie run the risk of saturation particularly during the summer months, tourist peak influx per day is high and leads to crowding, congestion and noise are obvious. This becomes more pronounced when too many humans, tourists and residents, concentrate in a small area, demanding quality environment, amenities and services. The floating population of Mussoorie ranges between 1.43 to 1.65 million approximately hardly maintains the hospitable mood when tourism makes an explosive demand on scare resources supply penetrating pressure on energy and water supply. The great influx of tourists cause unhygienic condition, environmental pollution, black marketing, bargaining and unplatable behaviour of local suppliers of amenities at the resorts especially at Mussoorie and Rishikesh. Mussoorie is experiencing the problem of congestion thus rendering entire tourism industry of Mussoorie unsustainable.

These few minor environmental side effects, the tourism industry encroachment can be corrected by strict public supervision and community's

active support. If Himalayan's environmental appeal is maintained the credit will go to environmentally conscious planners, resource managers and the users of these otherwise fragile resources.

(b) Socio-cultural Impacts

Tourism makes changes in the socio-cultural environment of the destination communities, particularly when the guests and the hosts have contrasting socio-economic background such as the tourists of the affluent societies of west and of domestic tourism. Negative impacts occur due to variant behaviour of the tourists and residents, namely, demonstration effects, change in residents, language, dress, life style, tradition and more resulting in acculturation. However, only some social impacts, pertaining to the quality of life of the host communicate can be marked in short period. Cultural impacts are long term changes and not easy to assess or measure. Critics also doubt whether tourism alone should be held responsible for many changes occurring at the destination in face of other vehicles of changes, operating simultaneously.

'Sufferance of local people' was due to crowding and crumpling of space, traffic snarls, noise pollution, high speed driving in the town, price rise, shortage of water supply and kerosene, more particularly during the high season. It is seen that tourism is also responsible for westernizing the society in peoples life style and architectural patterns, Hotels in the Himalayan region have shown change in their architecture and eventually change in settlement patterns in the region e.g. Mussoorie and Rishikesh.

Interaction and contact with foreign tourists has helped them in thought exchange and cultural sharing, but at the same time it has adversely affected 'our impressionable youth. It is seen that few residents fear culture identity and therefore are against 'tourist culture' which may harm the society.

Modification in settlement patterns and architectural designs not only confined to tourism but this aspect of change is part of technological advancement which sometimes, saves time and reduces the cost of construction. Infact, tourism can be special reason to resist the wave of change for culture conservation and harnessing the resource. This is very well established in the 'Kullu Valley of Himachal Pradesh'.

(c) Impact on the Economy

Improvement in the local economy is perhaps the most important reason for the development of tourism in the remote mountain areas. It is a fact that tourism has been the key factor in the growth and development of various regions in the Uttaranchal. It is true that tourism has encouraged seasonal dependence, low jobs for the locals and better jobs for the outsiders pursuing back the locals on many fronts; while on other hand, tourism has improved standard of living of the native population. A society that survives on subsistence economy can hardly afford the price hike caused by the tourism and the rich pilgrimage.

From the economic advantage of tourism development, three significant impacts could be at the local level; income generation, job creation and diversification of economy. Creation of jobs though characterised by seasonality, appears to be the only best local benefit which the community can hope for the tourism.

Tourism could not be developed in isolation, it should be integrated with other sectors of economy to make it eco-friendly. Agriculture, forestry, horticulture, handicrafts are other many important sectors whose co-operation or interaction can bring sustainability to tourism business (Siddiqui, 1998).

The city, headquarters of the district, is visited by a large number of tourists every year, many of them en-route to mussoorie. The climate of the city, is temperate. Even during summer, it is not so warm at Dehradun as in the district south of it. The Forest Research Institute which is world famous

for its research work in forestry and is the only institution of its kind in Asia is situated here. Besides, headquarters of the important establishments like the Oil and Natural Gas Commission, Survey of Indi, the Mlitary Academy is also located here. The Gurudwara built by Guru Ram Raj during the reign of Aurangzeb in the Dhamanwala locality of the town is a religious place of eminence. The other place of importance is the Robber's cave situated at a distance of about 8 Km from Dehradun. The cave is a natural picnic spot surrounded by hills where the water suddenly disappears from sight and goes underground only to reappear after a few yards in the form of a stream. The city has many beautiful rest houses and good hotels to provide accommodation to the tourists. For many years, it has been one of the best known educational centers in northern India. Dehradun is well linked by rail and road with Delhi, Bombay, Calcutta, Lucknow and Varanasi. In 2007, 3.5 million tourist visited Dehradun district among which 3.4 million were Indians and 29272 were foreigners.

Mussoorie : Mussoorie, the queen of hill stations, is famous for its scenic beauty, gay social life and entertainment. The excellent climate makes it an attractive holiday resort. Thronged by holidayers, it vibrates with gaiety and merry making during the summer season. There are no steep inclines and the more adventurous can undertake enjoyable excursions to various beauty spots in the vicinity. Mussoorie affords glorious views of the mighty Himalayan peaks.

Kempty falls which are about 11 kms from the town attract hundreds of people everyday. The Bhatt falls are also famous for scenic beauty. Though the tourist here is smaller than that of Kempty, yet it is a picnic spot near to the town. Another place of interest in the town is the Depot Hill, popularly known as 'Lal Tibba'. It is the highest point in Mussoorie and beautiful Himalayan panoroma is visible on all clear days from this spot. The Badrinath, Kedarnath, Bandarpoonch, Sri Kantha and Nanda Devi peaks can be seen from here. Camel's back hill can be reached by electric trolley. The

tops commands a very beautiful view both of the hills as well as the valley. On clear days, one can see even the Ganga and the Yamuna from here. Mussoorie is well connected by roads with Dehradun, Delhi, Roorkee and Saharanpur. There are some good hotels, recreation clubs and restaurants to cater the needs of the tourists.

Kalsi : Kalsi, situated at a distance of 41 kms from Dehradun is another place of tourist interest. The scenic beauty around Kalsi is picturesque. From the Yamuna upto Kalsi the land on the western back of the river is formed in two successive edges, each about 30 metres high. Near the foot of the upper ledge is the Kalso Stone containing one of Ashoka's edicts.

Lakhmandal: Lakhmandal is situated on the bank of Yamuna at a distance of 35 Km from Chakrata and 128 Km from Dehradun; to the antiquarion it provides considerable material of interest. It contains temples dedicated to siva, the five Pandava brothers, Parsuram and Kedar. In order to burn the pandavas, the Kauravas had built their 'Laksha Garh' (house of lac). The two remarkably well executed figures in stone of Arjuna and the other of Bhima are available in the village.

Sahastra Dhara : Sahasra Dhara, literally meaning, the thousand fold spring is situated at a distnce of 11 km from Dehradun. The place makes an ideal picnic spot and is of immense attraction of visitors. The water here has a fall of about 9 metres and leaves an incrustation of line of all its touches. Particles thus accumulating over the centuries have formed a projecting ledge, and a sort of cave, from the roof of which falls a perpetual shower. There is also a sulphur spring in which visitors often take bath. Its water is said to cure skin infections and passes other medicinal properties.

Dak Pathar : It is situated amist scenic surrounding at a distance of 45 kms north west of Dehradun on the left bank of the river Yamuna. The place is an ideal picnic spot of tourist interest.

Rishikesh : It is associated with Ram. According to legend he came on the advice of sage vasishtha to do penace for killing Ravana, the king of lanka. The town is situated on the right bank of the Ganga at a distance of about 42 kms from Dehradun. After the fairs at Hardwar, pilgrims, no longer deterred by the former difficulties of the journey, now visit the place in large numbers. There are scores of ancient temples and ashrams affording spiritual solace to pilgrims, the important among them being temple of Bharata, Puskar temple, Shatrughan temple, Lakshamana temple, Geeta Bhawan and the Punjab Kshetra (Census of India, 1981).

Table 6.3(i)

Number of Tourist (2001)

Name of the place	Indian	Foreigner	Total
1. Dak Pathar	28415	1785	30200
2. Sahastradhara	503048	7523	510571
3. Chakrata	15832	-	15832
4. Deer Park	44933	1238	46171
5. Lachchiwala	40200	438	40638
6. Tapkeshwar	117715	1575	119290
7. Lakha Mandal	6820	108	6928
8. Laxman Siddh	88208	-	88208
TOTAL	**845171**	**12667**	**857838**

Source : Dept of Tourism, Dehradun District, 2001.

Use of certain areas by visitors for recreation and amenity result in a range of ecological problems. The tourist intentionally or unintentionally creates undesirable impact:

1. Tourism has caused irreversible damage to physical environment, historic sites, monuments and also to wild life. Many coastlines have been altered. Tourists themselves have choked the narrow streets of historic cities and over crowded the picturesque country side. The fragile

ecosystem, particularly of the islands and also of the Himalayas has been affected. Pollution and irrevocable damage have been left behind.

2. Many species which are a part of our cultural heritage are starting to get wiped out.

3. Traffic due to pedestrians and vehicles alters the composition of vegetation. Building of roadways in the mountain system creates disturbances. Camping also brings with it certain ill effects. All of these factors, then, affect the ecosystem. The vehicles emit carbon dioxide, carbon monoxide, sulphur dioxide, hydrocarbons etc. These gases cause tuberculosis, lung cancer, asthma, etc. The garbage pollution in the hill resorts spread many diseases.

4. The great rush of tourist also destroys the ecosystem. The major source of water pollution is the human excreta. The refuse gets mingled with local streams lakes, ponds etc. the water gets polluted and causes typhoid, dysentery and many other diseases. It needs proper attention and proper sewer management.

5. Trampling of recreational areas cause some ill effects to the ecosystems. Vegetation is bruised by trampling and most species are either reduced in abundance or eliminated. Other effects of trampling are as follows :

   - The height of the vegetation and its flowering frequency are reduced.
   - Soil is compacted and water holding capacity is reduced due to trampling.
   - Tourist trample across restricted areas in the forests disturbing the wildlife and endangering their own lives. The killing of birds and animals by hunting, even the simple disturbance of birds and animals by sustained human pressure, create varying degrees of damage to the natural environment and may permanently affect the capacity of the environment for sustained recreational use.

Chapter 7

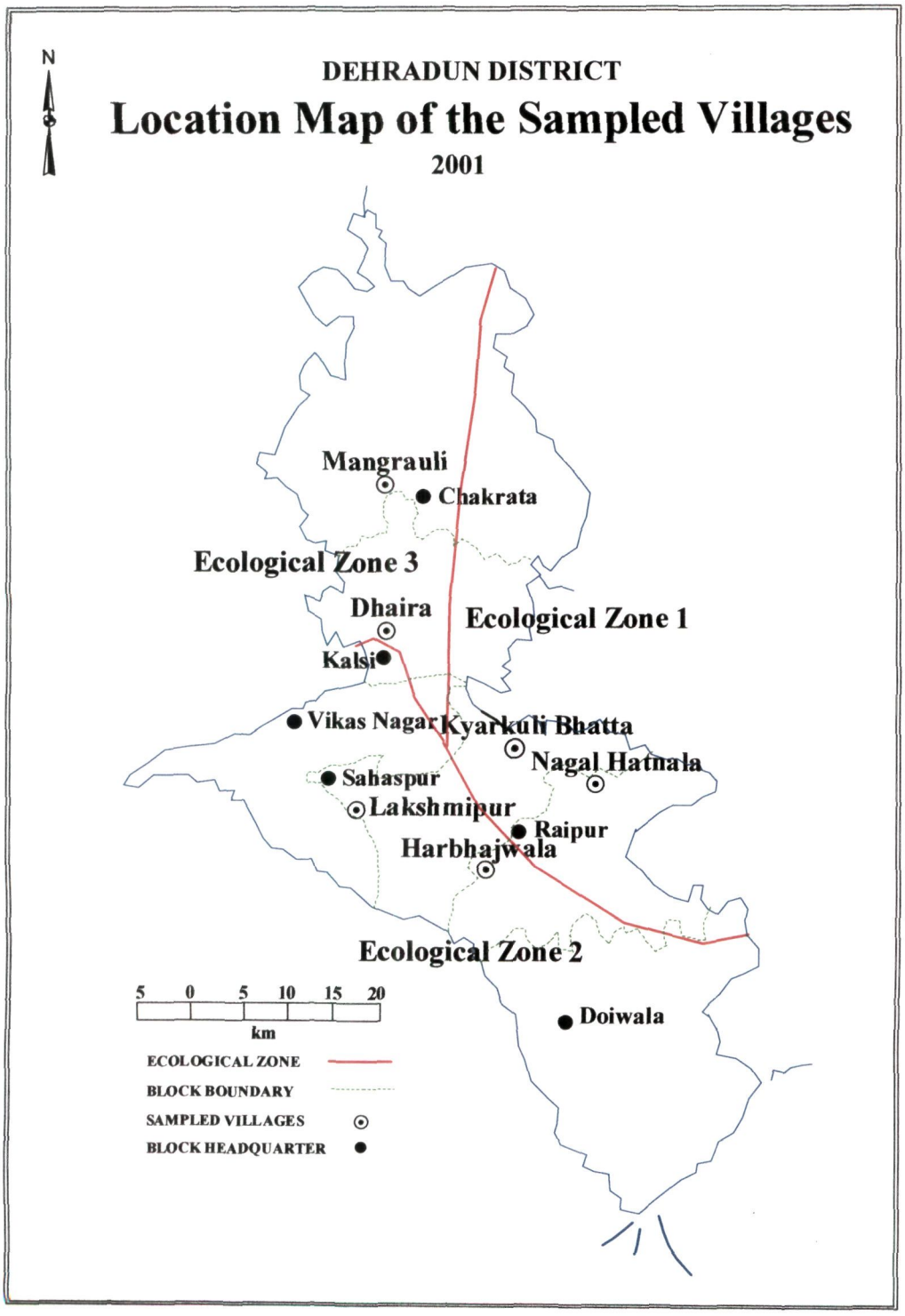
Ecological Profile of the Sampled Villages

Chapter – 7

ECOLOGICAL PROFILE OF THE SAMPLED VILLAGES

On the basis of structure, relief, drainage, climate, soil, water table, general land use pattern, size of the population, the area under study has been divided into three ecological zones and from each zone two villages have been selected for intensive environmental study. In the selection of these villages a part from physical factors, population and distance from the main urban centre were also taken into consideration. The location of the selected villages is shown in fig. 7.1. Among the three zones, zone I includes the villages of Nagal Hatnala and Kyarkuli Bhatta. The zone in which these villages lie is found elongated in north-south direction in the eastern part of the study area. The salient ecological parameters of this region are- very steep and steep slope are predominant (which is more than 300 mts/km), wheat and millet are the main crops and water table is high (more than 500 meters in the month of April). This zone is situated at an attitude of more than 1000 meters and mostly brown hill soils are found in this ecological zone.

The villages of Lakshmipur, Harbhajwala belong to ecological zone II and are located in the southern part of the Dehradun district stretching from north-west to south-east direction. The main ecological parameters observed in this zone are- moderately steep and gentle slopes are found which is less than 300 meters/km; wheat and rice are the main crops and some part is covered with forests, water table is moderate (below 500 meters) and in southern most part it is low (less than 400 meters in the month of April). This zone is situated at an attitude of less than 600 meters. Bhabar soil is predominant in this ecological zone. The III ecological zone includes the villages of Mangrauli and Dhaira. This zone covers the north western part of the Dehradun district. The dominant parameters of this zone are- Slope is steep that ranges between 300-600 meters/km; the entire zone is mostly covered with forests, water table is less than 500 meters in April, altitude is high (more than 1000 meters) and this zone is occupied by brown hill soil.



Source : Prepared by the Researcher, 2007

Fig. 7.1

Table 7.1

Dehradun District : Sampled Villages

Natural and Genetic Environment (in per cent)

Name of the villages	Fuel used			Size of land holdings					Source of irrigation			Agricultural implements		Type of farming		Number of animals per person
	Gas	Wood+ gas	Wood+ kerosene oil	Marginal (<1 ha.)	Small (1-2 ha.)	Semi-medium (2-4 ha)	Medium (4-10 ha)	Large (>10 ha)	Rainfed	Tubewell	Lake	Own	Hired	Bullock	Tractor	
Zone I Nagal Hatnala	33.33	22.22	44.44	17.74	82.26	-	-	-	100.00	-	-	60.00	40.00	100.00	-	0.21
Kyarkuli Bhatta	60.00	36.00	4.00	44.41	55.59	-	-	-	100.00	-	-	88.00	12.00	100.00	-	0.46
Zone II Harbhajwala	13.33	46.67	40.00	31.70	26.92	-	41.38	-	85.00	15.00	-	65.00	35.00	70.00	30.00	0.20
Lakshmipur	5.55	44.44	50.00	19.06	4.14	-	43.08	33.71	75.00	-	25.00	72.22	27.78	52.78	47.22	0.35
Zone III Mangrauli	5.00	40.00	55.00	29.35	70.65	-	-	-	100.00	-	-	80.00	20.00	100.00	-	0.72
Dhaira	13.00	36.36	50.64	13.37	26.67	20.00	29.45	10.51	70.00	-	30.00	77.00	13.00	86.00	14.00	0.95

Source : Surveyed by the researcher, 2007

The selected villages was visited by the researcher, villagers were interrogated for factual information regarding agricultural land use, type and condition of agricultural implements, methods of agricultural operations, the total population of each village together with the occupation and their general standard of living, their indoor housing environment, infrastructure and amenities and livestock.

Besides the factual study of a particular village, an exhaustive field accounts relating to the slope, drainage, water table in different seasons, soils, irrigation, size of holdings were prepared.

7.1 Natural and Genetic Environment

Table 7.1 represents the natural and genetic environment of sampled villages from three ecological zones of Dehradun district. The researcher analyzed the various variables like fuel used, size of land holdings, source of irrigation, agricultural implements, type of farming and number of animals per person. The variable fuel used has been further divided into three categories of gas only, wood and gas and wood and kerosene oil. The table 7.1 shows that in Nagal Hatnala village about 33.33 per cent respondents are using gas only while 22.22 per cent using wood and gas and 44.44 per cent using wood and kerosene oil, where as in Kyarkuli Bhatta village 60 per cent respondents are using gas only, 36 per cent using wood and gas while only 4 per cent are using wood and kerosene oil. The village is located on the main road to Mussorrie and more infrastructural facilities are available here.

Zone II comprises of Harbhajwala and Lakshmipur village. In Harbhajwala village 13.33 per cent respondents are using gas only, 46.67 per cent using wood and gas and 40.00 per cent are using wood and kerosene oil, whereas in Lakshmipur village about 5.55 per cent are using gas only, 44.44 per cent using wood and gas and 50.00 per cent using wood and kerosene oil. Zone III comprises two villages of Mangrauli and Dhaira. In Mangrauli village 5.00 per cent respondents are using gas, 40.00 per cent wood and gas and 55.00

per cent are using wood and kerosene oil while in Dhaira village only 13.00 per cent are using gas, about 36.36 per cent using wood and gas and 50.64 per cent using wood and kerosene oil.

As far as the size of land holdings are concerned, it is divided into five categories of marginal (<1 ha), small (1-2 ha), semi medium (2-4 ha), medium (4-10 ha) and large (>10 ha). In Nagal Hatnala village 17.74 per cent is marginal land holdings and 82.26 per cent small land holdings, whereas in Kyarkuli Bhatta village 44.41 per cent is marginal land holdings and 55.59 per cent small land holdings. It is due to the steepness of the slope and high altitude of the region. In Harbhajwala village of zone II, 31.70 per cent are the marginal land holdings, 26.92 per cent small land holdings and 41.38 per cent the medium size of land holdings while the Lakshmipur village has 19.06 per cent marginal land holdings, 4.14 per cent small land holdings, 43.08 per cent medium land holdings and 33.71 per cent large land holdings. The villages of this second zone have bigger land holdings in comparison to other zones because of its topography. The slopes are not steep, the land surface is plain and more irrigation facilities are available while in zone third the environmental conditions are worst, the altitude is high with low water table, slopes are steep and most of the area is forested having brown hill soil. The land holding size in Mangrauli village are marginal (29.35 per cent) and small 70.65 per cent) where as in Dhaira village 13.37 per cent land holdings are marginal, 26.67 per cent small, 20.00 per cent semi medium, 29.45 per cent medium and 10.51 per cent large land holdings. The land holdings are of various sizes because it is located in an agricultural block of the study area.

The villages of zone I are entirely dependent on rainfed agriculture. The village Harbhajwala of zone second receives only 15 per cent irrigation by tube wells whereas in Lakshmipur village 25 per cent irrigation is practiced by lake. On the other hand the agricultural practices in Mangrauli village of zone third are entirely dependent on rainfall. In Dhaira village 30 per cent irrigation is run by canal and rest is dependent on rainfall only.

In Nagal Hatnala village 60 per cent respondent have their own agricultural implements whereas 40 per cent hired these agricultural implements from others. In Kyarkuli Bhatta village about 88 per cent have own agricultural implements and 12 per cent hired these from others.

From zone II, 65.00 per cent respondents of Harbhajwala village have their own agricultural implements while 35 per cent hired from others. Whereas in Lakshmipur village 72.22 per cent respondents have their own agricultural implements and only 27.78 per cent hired these from others.

In the Mangrauli village 80 per cent respondents have their own agricultural implements and 20 per cent hired these agricultural implements where as in Dhaira village 77 per cent have their own agricultural implements and 13 per cent hired these from others.

The entire farming practices were done by bullock in Nagal Hatnala and Kyarkuli Bhatta villages of zone I because of small size of land holdings. Where as in zone second 70 per cent farming is done by bullock and 30 per cent by tractor in Harbhajwala village. In Lakshmipur village 52.78 per cent farming is done by bullock and 47.22 per cent by tractor due to the big size of land holdings. In zone third, 100.00 per cent farming is done by bullock in Mangrauli village where as in Dhaira Village 86.00 per cent farming is done by bullock and 14.00 per cent by tractor.

Livestock per person accounts 0.21 and 0.46 in Nagal Hatnala and Kyarkuli Bhatta villages respectively while in Harbajwala village number of livestock per person is 0.20 and in Lakshmipur village it is about 0.35; on the other hand in Mangrauli village the number of livestock per person is 0.72 and in Dhaira village it is 0.95 (as shown in table 7.1).

7.2 Socio-Economic Environment

The socio-economic environment is represented by the variables of family size, age structure and level of education. The average size of family in Nagal Hatnala village of zone I is 5.78 in which 2.45 (42.00 per cent) are males

Table 7.2

Dehradun District : Sampled Villages

Socio-Economic Environment (in per cent)

Village	Family size			Age structure									Education level	
	Average family size	Male	Female	0-14 (juvenile)			Work force 15-59			Dependents 60 & above			Educated	Un-educated
				Total	Male	Female			Female	Total	Male	Female		
Zone 1														
Nagal Hatnala	5.78	42.00	58.00	25.00	8.00	17.00	73.00	35.00	38.00	2.00	-	2.00	81.00	19.00
Kyarkuli Bhatta	4.36	57.00	43.00	17.00	11.00	6.00	75.00	41.00	34.00	8.00	5.00	3.00	91.00	9.00
Zone 2														
Harbhajwala	5.66	47.00	53.00	35.00	16.00	19.00	63.00	29.00	34.00	2.00	2.00	-	62.00	38.00
Lakshmipur	6.11	52.00	48.00	26.00	14.00	12.00	68.00	33.00	35.00	6.00	4.00	2.00	64.00	36.00
Zone 3														
Mangrauli	8.40	52.00	48.00	22.00	12.00	10.00	74.00	38.00	36.60	4.00	2.00	2.00	41.00	59.00
Dhaira	7.18	52.00	48.00	19.00	11.00	8.00	75.00	38.00	37.00	6.00	3.00	3.00	42.00	58.00

Source : Surveyed by the researcher, 2007

cent (14.00 per cent males, 12.00 per cent females), 68.00 per cent (33.00 per cent males, 35.00 per cent females) and 6.00 per cent (4.00 per cent males, 2.00 per cent females) respectively.

In zone III of Dehradun district, village Mangrauli has 22.00 per cent juvenile population in which 12.00 per cent are males and 10.00 per cent are females. The working population is 74.00 per cent out of which 38.00 per cent are males, 36.00 per cent are females and only 4.00 per cent are dependents (2.00 per cents are males and 2.00 per cent are females). In Dhaira village 19.00 per cent is juvenile (11.00 per cent males, 8.00 per cent females), 75.00 per cent work force (38.00 per cent males, 37.00 per cent females) and 6.00 per cent dependents (3.00 per cent males, 3.00 per cent females) (Table 7.2). Although work force constitutes more than two-third of the total population, but most of them are theoretical workforce not actual work force due to mass level unemployment in all the villages of Dehradun district. Therefore, it is the need of the hour to provide employment opportunities to the youth in rural Dehradun to improve the socio-economic conditions of the people.

Education is the most important parameter to judge the socio-economic and cultural environment in any area. It has been observed that in Nagal Hatnala 81.00 per cent are educated and 19.00 per cent are uneducated while in Kyarkuli Bhatta 91.00 per cent are educated and only 9.00 per cent are uneducated while in the villages of zone II, Harbhajwala have 62.00 per cent educated population and 38.00 per cent uneducated. In Lakshmipur village 64.00 per cent are educated and 36.00 per cent uneducated.

In zone III the villages record the lowest educational level; in Mangrauli village 41.00 per cent are educated and 59.00 per cent uneducated while in Dhaira village 42.00 per cent are educated and 58.00 per cent uneducated. The primary level education is available in all the surveyed villages, so most of them are primary literates.

7.3 House hold Environment

Housing and sanitation conditions represent the best parameters to analyze the social environment of a particular region. In this survey an assessment of certain parameters of house hold like housing type, food habit, drainage around the house, water logging, mode of storage of waste, mode of disposal of waste and frequently reported diseases have been made.

As shown in table 7.3 from zone I, Nagal Hatnala village has 22.2 per cent thatched houses and 77.78 per cent cemented houses. 61.54 per cent are vegetarian and 38.46 per cent non vegetarian, 33.3 per cent drainage exist around the house and 66.67 per cent houses do not have drainage facility, 66.67 per cent rain water and 33.33 per cent waste water is logged around the houses. 95.00 per cent wastes are stored in open containers only 5.00 per cent waste in closed container and 33.33 per cent waste is disposed on road side and 66.67 per cent burned out. The diseases which were frequently reported in this village are pneumonia, cough and cold, typhoid, gastric disorder. In Kyarkuri Bhatta village 4.00 per cent houses are thatched and 96.00 per cent cemented, 44.04 per cent are vegetarian and 55.96 per cent non vegetarian. About 92.00 per cent drainage exist around the house and no water logging is observed in this village because it is located on high altitude. 82.00 per cent waste is stored in open containers and only 18.00 per cent in closed containers; 72.00 per cent respondents dispose their wastes on roadside and 28.00 per cent burn these wastes. The reported diseases of this village are cough and cold and Pneumonia. Zone II comprises of two villages i.e. Harbhajwala, and Lakshmipur (Table 7.3). Village Harbhajwala recorded 26.67 per cent thatched houses and 73.33 per cent cemented houses. 41.18 per cent respondents are vegetarian and 58.82 per cent non vegetarian; 40.00 per cent houses fulfilled drainage facility while 60.00 per cent houses do not have drainage facility, 46.67 per cent rain water is logged; 91.00 per cent respondents store wastes in open containers only 9.00 per cent in closed containers; 53.33 per cent dispose their wastes on roadside and 46.67 per cents burn these wastes. Diseases

Table 7.3

Dehradun District : Sampled Villages

Household Environment (in per cent)

Name of the village	Housing type		Food Habit		Drainage around the house		Water logging		Mode of storage of waste		Mode of disposal of waste		Frequently reported diseases
	Thatched	Cemented	Veg	Non-veg	Exist	Not exist	Rain water only	Waste water	Open container	Closed container	Road side	Burn	
Zone 1													
Nagal Hatnala	22.22	77.78	61.54	38.46	33.33	66.67	66.67	33.33	95.00	5.00	33.33	66.67	pneumonia, cough & cold, typhoid, gastric disorder
Kyarkuli Bhatta	4.00	96.00	44.04	55.96	92.00	8.00	-	-	82.00	18.00	72.00	28.00	cough & cold, pneumonia
Zone 2													
Harbhajwala	26.67	73.33	41.18	58.82	40.00	60.00	46.67	-	91.00	9.00	53.33	46.67	malaria, typhoid, gastric problem
Lakshmipur	56.11	43.89	7.73	92.27	66.11	33.88	86.11	13.89	87.00	13.00	27.78	72.22	malaria, typhoid, stone, thyroid
Zone 3													
Mangrauli	60.00	40.00	83.33	16.67	20.00	80.00	-	-	94.00	6.00	40.00	60.00	cough & cold, pneumonia
Dhaira	54.54	45.46	82.28	17.72	27.27	72.73	45.45	-	96.00	4.00	36.36	63.64	cough & cold, pneumonia, gastric disorder

Source : Surveyed by the researcher, 2007

reported in this zone are malaria, typhoid, thyroid, stones in gall bladder and kidney. In village Lakshmipur 56.11 per cent are thatched houses and 43.89 per cent cemented; 7.73 per cent are vegetarians and 92.27 per cent non-vegetarians: 66.11 per cent houses have drainage facilities while 33.89 per cent do not have drainage facility; 86.11 per cent rain water and 13.89 per cent waste water is found logged in the village. 87.00 per cent store the wastes in open containers while 13.00 per cent store in closed containers. 27.78 per cent dispose their wastes on road side and 72.22 per cent by burn method. Diseases frequently reported in this village are, malaria, thyroid, typhoid, gastric disorder, cold and cough.

Zone III comprises of Mangrauli and Dhaira villages. In Mangrauli village 60.00 per cent are thatched houses and 40.00 per cent cemented; 83.33 per cent are vegetarians and 16.67 per cent non vegetarians. 20.00 per cent households have drainage facility while 80.00 per cent does not, have this facility. No water logging was observed in this village because it is located on high altitude. 94.00 per cent respondents store their wastes in open containers while only 6.00 per cent in closed containers; 40.00 per cent dispose the waste on road side while 60.00 per cent burn the waste, cough and cold, pneumonia are frequently reported diseases. In Dhaira village 54.54 per cent are thatched houses and 45.46 per cent cemented. 82.28 per cent are vegetarians and 17.72 per cent non vegetarians. 27.27 per cent household has drainage facility while 72.73 per cent do not have this facility. About 45.45 per cent rain water was logged in this village. 96.00 per cent store their waste in open containers while 4.00 per cent in closed containers. 36.36 per cent dispose off waste on road side and 63.64 per cent burn these wastes. Cough and cold, pneumonia, gastric disorder are the diseases which were commonly reported in this village.

7.4 Mode of employment and Income level

Employment is one of the most significant segment of a population of a nation. It has multilateral involvements in the economic production and planning. Employment provides information about the human resources and the nature and extent of their utilization.

Table 7.4

Dehradun District : Sampled Villages

Mode of Employment and Income level (in per cent)

Name of the village	Employment level		Employment Sector			Source of Income			Monthly Income			
	Employed	Unemployed	Primary	Secondary	Tertiary	Agriculture	Non-Agriculture	Total	Below 2000	2000-4000	4000-6000	Above 6000
Zone 1 Nagal Hatnala	27.00	73.00	17.31	9.61	-	33.33	66.67	100.00	22.22	44.44	11.11	22.22
Kyarkuli Bhatta	32.1	67.9	08.76	17.84	5.50	35.00	65.00	100.00	-	12.00	32.00	56.00
Zone 2 Harbhajwala	22.35	77.65	14.12	5.88	2.35	36.67	63.33	100.00	6.66	33.33	40.00	20.00
Lakshmipur	27.27	72.73	20.00	5.45	1.82	58.33	41.67	100.00	2.78	27.78	44.44	25.00
Zone 3 Mangrauli	21.43	78.57	16.67	4.76	-	55.00	45.00	100.00	10.00	60.00	20.00	10.00
Dhaira	25.32	74.68	20.25	5.06	-	65.00	35.00	100.00	9.09	36.36	27.27	27.27

Source : Surveyed by the researcher,2007.

Structure of employment refers to the distribution of working force into various sectors of economic activity. An employment is defined as an economic activity which provides means of livelihood to those engaged in it.

Table 7.4 represents the employment level composed of two variables of employed and unemployed while employment sector is divided into primary occupation, secondary occupation and tertiary occupation. As shown in Table 7.4. 27.00 per cent are employed, out of which 17.31 per cent are engaged in primary occupation and 9.61 per cent engaged in secondary occupation on the other hand 73.00 per cent are unemployed in Nagal Hatnala village of zone I. In Kyarkuli Bhatta village of this zone 32.10 per cent are employed in which 8.76 per cent are engaged in primary occupation, 17.84 per cent are engaged in secondary occupation and 5.50 per cent in tertiary occupation, while 67.90 per cent are unemployed

Zone II is composed of Harbhajwala and Lakshmipur village, 22.35 per cent are employed in Harbhajwala village out of which 14.12 per cent are engaged in primary occupation, 5.88 per cent in secondary occupation and 2.35 per cent in tertiary occupation. On the other hand 77.65 per cent are unemployed. In Lakshmipur village 27.27 per cent are employed in which 20.00 per cent are engaged in primary occupation, 5.45 per cent in secondary occupation and 1.82 per cent in tertiary occupation while 72.73 per cent are unemployed.

Mangrauli and Dhaira village come under zone III of the study area. As shown in Table 7.4, 21.43 per cent are employed out of which 16.67 per cent are engaged in primary occupation and 4.76 per cent in secondary occupation while 78.57 per cent are unemployed in Mangrauli village. While in Dhaira village 25.32 per cent are employed out of which 20.25 per cent are engaged in primary occupation, 5.06 per cent in secondary occupation and 74.68 per cent are unemployed.

As far as source of income and monthly income of the household is concerned, 33.33 per cent income comes from agricultural sector while

remaining 66.67 per cent is generated from non agricultural sector in Nagal Hatnala village. 22.22 per cent households have income below Rs.2000 while 44.44 per cent households have income between Rs.2000 and 4000, 11.11 per cent earn between Rs.4000 and 6000 and 22.22 per cent households have income above Rs.6000 in this village of zone I. On the other hand in Kyarkuli Bhatta village, 35.00 per cent income is generated through agricultural sector and 65.00 per cent from non-agricultural sector. No household comes below Rs. 2000 category; about 12.00 per cent household have monthly income between Rs.2000 and 4000, 32.00 per cent households have monthly income between Rs.4000 and 6000 and 56.00 per cent households have monthly income above Rs.6000. In Harbhajwala village of zone II, 36.67 per cent income is generated through agricultural sector while 63.33 per cent from non-agricultural sector. About 6.66 per cent households have monthly income below Rs.2000, 33.33 per cent between Rs.2000 and 4000, 40.00 per cent between Rs.4000 and 6000 and 20.00 per cent above Rs. 6000. In Lakshmipur village, 58.33 per cent income comes from agricultural sector and 41.67 per cent from non agricultural sector. As far as monthly income is concerned 2.78 per cent household earn below Rs.2000, 27.78 per cent between Rs.2000 and 4000, 44.44 per cent between Rs.4000 and 6000 and 25.00 per cent households above Rs.6000.

In Mangrauli village 55.00 per cent income is generated through agricultural sector while 45.00 per cent from non-agricultural sector. 10.00 per cent households have monthly income below Rs.2000, 60.00 per cent households have monthly income between Rs.2000 and 4000, 20.00 per cent have monthly income between Rs.4000 and 6000, and 10.00 per cent have monthly income above Rs.6000. In Dhaira village 65.00 per cent income comes from agricultural sector while 35.00 per cent from non-agricultural sector. About 9.09 per cent households have monthly income below Rs. 2000, 36.36 per cent between Rs. 2000 and 4000, 27.27 per cent between Rs.4000 and 6000 and 27.27 per cent above Rs.6000 (Table 7.4).

7.5 Infrastructural Development

Infrastructure embodies the many connections of modern life. Telecommunication facilities, electrical connections, road and other transport networks, and water and sanitation system all hold the promise of greater convenience and opportunities for Indian households. Rural areas pose severe obstacles to the expansion of infrastructure. Population is scattered, so conventional networks are often too expensive and inefficient. Incomes are low, so households are often reluctant to invest their limited resources in the vehicles, telephones, electric appliances, or other equipments that could take advantage of new infrastructure development.

1. All the villages of Dehradun district have school facilities mainly up to the primary level but in Nagal Hatnala and Kyarkuri Bhatta village school facility has been observed upto the middle level.
2. Kyarkuli bhatta of zone I and Harbhajwala and Lakshmipur village of zone II have medical facilities while other villages like Nagal Hatnala, Mangrauli and Dhaira villages do not have medical facilities. For this facility they go to their nearest towns.
3. All the six sampled villages have drinking water facility, specially the tap water provided by the government of Uttaranchal.
4. All the villages are electrified.
5. Nagal Hatnala, Kyarkuili Bhatta of zone I and Harbhajwala and Lakshmipur villages of zone II have paved roads while Mangrauli village of zone III have only foot path and mud road is available for accessibility to the Dhaira village.
6. Nagal Hatnala village do not have communication facility and bus service facility while Kyarkuri Bhatta enjoys both the facilities. Harbhajwala village have telephone service while no any bus service is available there. Lakshmipur village have only bus service facility. On the other hand

Mangrauli village of zone III is lacking in both the facilities while Dhaira village have post office and bus service facility.

NATURAL AND GENETIC ENVIRONMENT

Zone I- The villages of zone I are located in Raipur and Sahaspur blocks. In terms of distribution of forests, both these blocks come under the medium grade as discussed in chapter four of the present thesis. A perusal of Table 7.1 represents that about 40.00 per cent respondents are using wood as fuel because forest products are easily available especially in Nagal Hatnala village, while in Kyarkuli Bhatta most of the respondents are using gas.

As far as genetic environment of the study area is concerned, Raipur block shows low level of agricultural as well as livestock development. On the other hand Sahaspur block comes under the medium grade. The sampled villages of this ecological zone have mostly marginal and small land holdings. The kyarkuli Bhatta village is located in a high altitude region of the north eastern part of the Sahaspur block. The western part of this block represents a level topography with fertile soils. The block represents medium level of agricultural development. Number of livestock in the sampled villages represents low and medium level of development.

Zone II- The villages of ecological zone II are located in Raipur ansd Sahaspur blocks. About 60.00 per cent respondents are using wood in zone II. As stated earlier that these blocks fall under the medium grade in terms of distribution of forest. Whereas size of land holdings is concerned, 60.00 per cent are of marginal and small size, while 40.00 per cent are of medium size in Harbhajwala village of Raipur block but this block shows low level of agricultural development. Lakshmipur village shows a little less than of 25.00 per cent land holdings belonging to the small and marginal size, while more than 65.00 per cent are of medium and large size. This block also shows low level of agricultural development.

Raipur block as well as Harbhajwala village of zone II shows low level of livestock development. On the other hand Sahaspur block as well as Lakshmipur village of this block show medium level of livestock development.

Zone III- The villages of this zone are located in Kalsi block, which shows a low forest cover, high agricultural development and high livestock development. Mangrauli village of this zone is located on the border line of Kalsi and Chakrata block. In zone III about 75.00 per cent respondents are using wood as fuel, because in Mangrauli village they collect wood from forested areas of Chakrata, while in Dhaira village they usually use agricultural and livestock waste as fuel. Mangrauli village have mostly marginal and small size of land holdings because it is located on a hilly track while Dhaira village shows high level of agricultural development and bigger size of land holdings. As far as livestock is concerned both the villages as well as the block show high level of livestock development.

SOCIO-ECONOMIC DEVELOPMENT

Zone I- In terms of population densities Raipur block come under the high grade because this block is more urbanized, industrialized and developed. Most of the urban centers lie in this block, which make this block highly populated. The Sahaspuer block show medium level of population density as discussed in chapter sixth of the present study. The villages of zone I are located in these blocks. Nagal Hatnala village shows medium size of family while Kyarkuli Bhatta shows smaller size of family because the educational level in these villages is highest among all the villages. These villages are more developed in comparison to others. More amenities and facilities are available in these villages.

Zone II- The villages of ecological zone II show medium level of family size. These two villages are moderately developed. These villages are also located in Raipur and Sahaspur blocks. The educational level in these villages is medium.

Zone III- Zone III villages are located in the Kalsi block. The villages Mangrauli and Dhaira have bigger size of family. Educational level is lowest in this zone. As discussed in chapter sixth, this block shows low level of composite population density because this block do not have any urban center. These two villages of zone III show bigger family size but the number of households are limited and countable.

Conclusion and Suggestions

CONCLUSION AND SUGGESTIONS

The present study of 'Ecology and Environmental Management in Dehradun District' starts with the general description of concepts and methodologies used in the studies of ecology and environment.

The geographical profile of the study area has been well documented and described in the form of physical, economic and social settings.

The study of the natural environment focuses with the theme of forest and mining. As far as the distribution of forest is concerned, Chakrata block has registered the highest composite score, whereas the lowest composite score has been recorded in Kalsi and Vikas Nagar blocks because the topographic and climatic conditions in Chakrata block are favourable for the growth of forest while the Kalsi and Vikas Nagar blocks are mainly agricultural blocks so more and more forested area has been cleared for the cultivation of crops. The other blocks of the study area show medium level of distribution of forest. 0n the other hand mining is another aspect of natural environment. The study region is well known for their economic potentiality due to abundance of economic minerals like limestone, limestone marble, phosphorite and gypsum. All these minerals are located in the Krol belt viz infra krol, krol and Tal formations. The study reveals that haphazard and unscientific mining operations destabilize slopes, lead to excessive soil erosion and landslides, formation of badlands, generate dust and noise. Now a days mining is banned in the district.

It has been concluded through the study of genetic environment that high level of agricultural development is found in the upper central part of the study area. This portion attained this status due to a variety of reasons. The farmers living in this portion enjoy better irrigation facilities; cropping intensity is high with plenty of agricultural workers coupled with more production of food grains. The medium level of agricultural development is found in the lower central part of the study area. In 1981 and 19991 Raipur block was in the

medium grade but in 2001 it came in low grade because in 2000 Dehradun district become the capital of Uttarakhand state so more and more non-agricultural development has taken place. Chakrata block shows low level of agricultural development in all the three decades because of its topographic and climatic conditions. Chakrata and Kalsi blocks record high level of livestock development, because these blocks are less populated and have more rural pockets. Vikas Nagar and Sahaspur blocks, located in the center of the district, show medium level of livestock development in all the three decades. In the previous decades Doiwala block was under the medium grade but in the last decade it came under the low grade whereas Raipur block shows low level of livestock development in all the three decades.

Population, urbanization and tourism are the main aspects of socio-economic environment. The population growth shows two discernible trends, a decreasing population trend till 1921 and a continuous increase since 1921. As a result of increased health care the mortality rate has gone down and the family planning measures have not been able to control the growth of population. During the last decade, 1991-2001, there is an increase in population by 25.00 per cent. As far as composite population densities are concerned, the upper part of the district shows low composite population densities, while the central part represents the medium level and the lower part of the district shows high level of composite population densities in all the three decades. Only Doiwala block which is located in the southern most part of the region, was under the medium grade in 1981 and 1991 but in 2001 it came in the high grade. Another aspect of socio-economic environment is urbanization. The district is divided into six development blocks and five blocks out of six have urban population. Kalsi block is totally a rural area so this block has not been incorporated in the study of urbanization. Raipur block is the most congested, urbanized and developed because major urban centers of the district are located in this block, so this block shows high level of urbanization in all the three decades. Chakrata block is the least urbanized and

developed because only one urban center i.e. Chakrata cantt is located in this block. This block lies under the low grade in all the three decades. Another block Vikas Nagar also falls in the low grade in 2001 but in previous decades it was under the medium grade. In fact, a reflection of higher levels of industrial and economic development is observed in the southern part of the district. Another aspect of the study is the tourism. The movement of people even for short duration as tourist from one place to another is responsible for impacting economic, socio-cultural and ecological set up of any locality. Excessive development of tourism in the region has begun to destroy that attributes which attract the visitors. Main tourist spots of the study area are Mussorrie, Kalsi, Lakhamandal, Sahastradhara, Dak Pathar and Rishikesh. All the tourist places attract people from various parts of the country and abroad.

The last chapter of this present thesis is based on primary survey. The primary data obtained through a detailed survey confirms the findings of the secondary data. In the blocks where forests are in abundance, wood is used as fuel for cooking. Only in Kyarkuli Bhatta village about 60.00 per cent respondents were using gas as fuel. Villages which are located on the main road and close to urban centers enjoy more facilities and amenities in comparison with those villages located in the remote areas. The study confirms that the villages situated in the hilly tracks have marginal and small size of land holdings while the villages located in the plain topography have bigger size of land holdings. For example zone I villages and Mangrauli village of zone III are located in the hilly track, while zone II villages and Dhaira village of zone III are located in the plain topography. In almost all the villages, the main source of water for agriculture is rain fed. Most of the respondents have their own agricultural implements. Mostly, farming is done by bullocks because of small size of land holdings; those respondents who have big land holdings, farming is practiced by tractors.

The socio-economic environment is represented by the variables of family size, age structure and level of education. The average size of family is

5.78, 4.36, 5.66, 6.11, 8.4 and 7.18 in Nagal Hatnala, Kyarkuli Bhatta, Harbhajwala, Lakshmipur, Mangrauli and Dhaira villages respectively. Although workforce constitutes more than two-third of the population, but most of them are theoretical workforce not actual workforce due to mass level unemployment in all the villages of the study area. Education is the most important parameter to judge the socio-economic and cultural environment in any area. Again the educational level is highest in Kyarkuli Bhatta village and lowest in Mangrauli village. Among the educated, majority are the primary literates because primary school facility is available in all the villages. The study finds a very interesting result in the house hold environment. About 75.00 per cent houses in zone I and zone II are cemented while in zone III this figure is 45.00 per cent. More vegetarians are found in Nagal Hatnala, Mangrauli and Dhaira villages while non-vegetarians are common in Kyarkuli Bhatta, Harbhajwala and Lakshmipur village. Lakshmipur village shows higher percentage of non-vegetarians because this is a Muslim dominated village. Most of the villages do not face the problem of water logging because of their location in high altitudes. Only zone II villages are located in low altitudes, some of them face the problem of water logging, mainly the rain water, for a short period of time. The frequently reported diseases in almost all the villages are cough and cold, gastric disorder, thyroid, pneumonia, stones in gall bladder and kidneys. The major environmental problems observed in the study area are the land slides, earthquakes and the cloud burst.

The economic aspect of the study has been demonstrated by the mode employment and income level. All the villages are facing the problem of unemployment. The percentage of employment ranges between 21 and 32 in all the villages. They are mainly employed in primary sector. Only in Kyarkuli Bhatta village some of them are employed in secondary and tertiary sector. The source of income in Lakshmipur, Mangrauli and Dhaira villages is from the agricultural sector while in Nagal Hatnala, Kyarkuli Bhatta and Harbhajwala, it is mainly from non-agricultural sector.

The study reveals that all the sampled villages enjoy the school facility mainly up to the primary level and few villages have medical facility too. Drinking water facility is available in all the villages. The villages are electrified and most of them enjoy bus service facility.

The present study reveals that most of the forest cover is found concentrated in the northern part of the study area. Agricultural development is more pronounced in the upper central part of the region. The development of livestock has been recorded in the northern part of the district due to favourable ecological conditions. The highest concentration of population has been observed in the southern part of the area having a highly urbanized and developed Raipur block. The influx of tourist is recorded more in Mussorrie and Rishikesh.

Some of the suggestions are:

- Agriculture itself has been one of the main causes for the destruction of many previously forested areas. The demand for food, fodder and raw materials has reduced the forest cover to a certain extent. In order to sustain a healthy life, forest cover should be at least 33 per cent.
- Livestock is one of the major contributors to the degradation of the environment and to soil erosion. There is no doubt that there is an urgent need for a strong policy with appropriate guidelines and sustainable administrative machinery to control and regulate the animal population.
- The trend towards excessive urbanization can certainly be checked, regulated and slowed down by a systematic well planned policy of restricting the migration of rural population to towns; of course it is neither advisable nor practicable to impose legal restriction on the exodus of people from the villages to towns and cities. Therefore the problem should be tackled in a rational way.
- It is necessary that while planning the development works due considerations should be paid to safeguard the environment. Tourism,

economic development and environment have to go hand in hand and should be developed in a symbiotic relationship.

- In the opinion of the researcher, the ecological resource management and its judicious utilization together with the maintenance of the quality of the environment. In order to bring about its economically productive, socially equitable and environmentally sustainable use of the following four major approaches, namely the ecological, the economic, the technological and the ethnological are suggested. Therefore, the community based participatory approaches to ecological management is the practical option.

Glossary

GLOSSARY

Agla	*Acacia pennata*
Alai	*Cascal piniadecapetala*
Amaltas	*Cassia fistula*
Amarbel	*Cayratia carmosa*
Asna	*Ternunalia tomentosa*
Ayar	*Pieris oualifolia*
Bahera	*Ternunalia to belerica*
Bakli	*Anogeis-sus latifolia*
Bamboo	*Dendrocalamus strictus*
Ban	*Glycosmis pentaphylla*
Bansa, Besinga	*Adhatoda vasika*
Bhabar	*Eulaliopris binata*
Bhang	*Cannakis sativa*
Bhilawa	*Semecarpus anacardium*
Bhilmora	*Rumex hastatus*
Bindu	*Heleti rookia*
Burans	*Rhododendronar boreum*
Chameli	*Tasmix-un arborascens*
Chamror	*Ehrctia lacvis*
Chilla	*casearia tomentosa*
Dhaman	*Grewia clastica*
Dhaula	*Woodfordia floribunda*
Dhauri	*Lagenst reemia parviflora*
Gandela	*Murraya keonigu*
Goria	*Chrysopogon contratus*
Guiral	*Bauhinia* spp.
Gular	*Ficus ghomerata*
Haldu	*Adina cordifolia*

Harsingar	*Nyctanthes anbortristis*
Hisala	*rubus elliplicus*
Jhingan	*Lannea grandis*
Kachhar	*Banhini avari egata*
Kalidudhi	*Ichmocarpus frustescens*
Karaunda	*Carrisa opaca*
Karu	*Clerodendron enfortunatum*
Kharpat	*Garuga pinnata*
Khinni	*Sapuim insigne*
Kilmora	*Berberis asiatica*
Kumaria	*Hcteropogon contortus*
Kuri	*Lantana camera*
Maidalakari	*Litsca chinesis*
Malijan	*Banhinia vahili*
Mehal	*Pyrus pasha*
Nakli bhabar	*Ereophorum coinosum*
Pipal	*Buchanania lanzan*
Ringal	*Arundinarea fuleata*
Rohini	*Mallotus phillipinensis*
Sakina	*Indigofera pulchella*
Sal	*Shorea robusta*
Sande	*Grcura elastica*
Satawar	*Asparagus reiemosus*
Semal	*Salmatia malabarica*
Suru	*Euphorbia rouleana*
Thor	*Euphorbia ronyhana*
Tun	*Cedrela toona*
Vasica	*Adhatoda vasica*

Appendix

Appendix

QUESTIONNAIRE

Ecology and Environmental Management in Dehradun District

S.No ..... Block .....Tehsil .....Location Code.....

1.Name of the head of household .....

2. Sex ..... Age ..... Religion ..... Caste.....

3. Martial Status: Married/ Unmarried/ Separated/ Divorced/ Widowed .....

4. If married/ Number of Children .....

5. Family size:

Relationship with Householder	M/F	Age	Marital Status	Educational Level	Level of Employment

6. Food Habit: Vegetarian .....Non vegetarian .....

7. Fuels used in cooking and heating .....

8.Type of Kitchen.....

9.Type of Latrine.....

10.Housing type.....

11.What is the source of light in your houses? Kerosene oil/ electricity/ lamp/ any other

12.Accessibility to the house: Pucca road/ katcha road/ kharanja

13.House water supply.

a. Source of water supply
   (i) Private : Own hand pump/ Piped water connection/ Own tube well

(ii) Public : Road side hand pump/ road side piped / Open well

b. State of water supply. (i) Regular (ii) Not regular

c. Quality of water supply (i) Satisfactory (ii) Unsatisfactory

d. Amount of water supply. (i) Sufficient (ii) Not sufficient.

e. Distance to fetch water .....

f. Mode of water storage. (i) In open containers (ii) In closed container

14. Sullage and drainage of water
    a. Disposal of household waste water
       (i) Into the nali (ii) Around the house (iii) In the house itself

    b. Drainage around the house. (i) Exists (ii) Does not exists

    c. If exists, type of drainage. (i) Open (ii) Closed

    d. Water logging around the house. (i) Yes (ii) No

    e. Types of water logged. (i) Rain water only (ii) Waste water only (iii) Both

15. Household garbage and solid waste.
    a. Mode of storage of household waste inside the house.
       (i) In open containers (ii) In closed containers (iii) Do not store.

    b. Mode of disposal of household wastes.
       (i) Official dumps (ii) Collections points (iii) Road side (iv) Burn

    c. Garbage in the village (i) Spread every where (ii) Not seen.

    d. If spread everywhere. (i)In huge quantity (ii)In small quantity (iii)Negligible

16. Environmental Awareness.
    a. Do you feel that the quality of water, food and surrounding environment lead to the various diseases ?
       (i) Agree (ii) Disagree (iii) Can not say.

17. Household environment and health.
    Name the four most frequently reported diseases of the family.
    (i) Pneumonia (ii) Malaria (iii) Cough and Cold. (iv) Typhoid (v)Jaundice (vi)Asthama. (vii)T.B. (viii)Gastroenteritis (xi) Skin disease (x) Bronchitis.

18. Do you get any health care facility? Yes/ No

19. If yes, what type of facility?
Children are immunized/ Mother care facility/ P H C/ PrivateDoctors/ Hakim/ Vaid

20. Do you gather fruits and roots of the trees?..... Gathering days in a year.....

21. Number of animals,..... Cows.....Buffaloes.....

Goat.....Sheep.....Pig.....Others.....

22. Source of fodder .....

23. What is the purpose for keeping these animals? .....

24.Do you own any piece of land? Yes/ No

25. If yes, what is the size of land holding? .....

26. Do you work in your own field? Yes/ No

27. Do you have agricultural implements? .....

28. Which factors do you affect regarding the decision making process of growing crops?

Irrigation/ HY Seeds/ Labour/ Fertilizers/ Prices etc

29. Sources of Irrigation: Tube Well/ Well/ Ponds/ Lake/ Rivers/ others .....

30. Type of Farming: Tractor Operated/ Bullock Operated/ Both

31. Is it self-sufficient or do you sell your produce in the market? .....

32. Regulated Markets/ Sub Markets. Distance from the Village .....

33.Village Market- Daily/Periodic: Bi weekly/tri weekly. Mode of transportation.....

34. What is the source of income? Agricultural sector/ Non Agricultural sector/ other

35.Monthly income..... Annual income.....

36.What is the impact of new agricultural technology on your employment and income?

(a)..... (b) .....

(c) ..... (d) .....

37. Education: Uneducated/ Educated : Up to what class? .....

38.Do you have any school facility in your village? .....

39. Employment Status: Worker/ Non worker/ Main/ Marginal?others.....

40. In what sector are they employed? .....

41. What is the reason for doing work? .....

42. How many family members do migrate outside the village in search of employment?..

43. Why do they migrate? .....

44. Type of migration? Daily/ Seasonal .....

45. Place of destination .....

46. What type of work they perform there? .....

47. Are you aware of various programmes floated by the government like Anti-Poverty, Minimum Wage Act and Family Planning Programmes? .....

48. Are you benefited by these programmes Yes/ No .....

49. Major environmental problems (a) ..... (b) .....

(c) .....(d) ..... (e) .....

(f) .....(g)..... ..(h).....

50. Measures to overcome them (a) .....(b).....

(c)..... (d).....(e).....

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Date of Survey..... Invigilator's Signature

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